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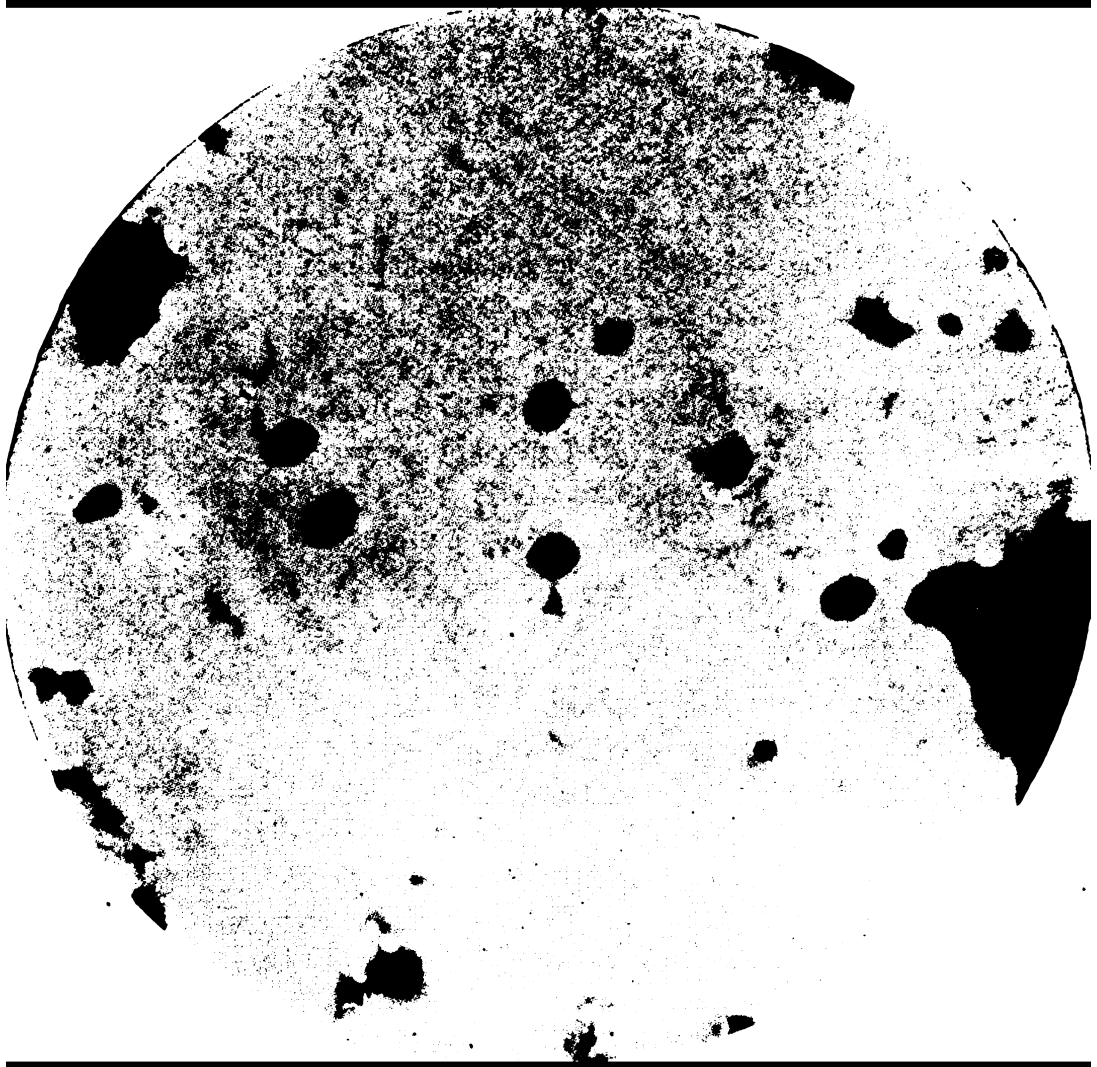

# Transactions

American Gastroenterological Association

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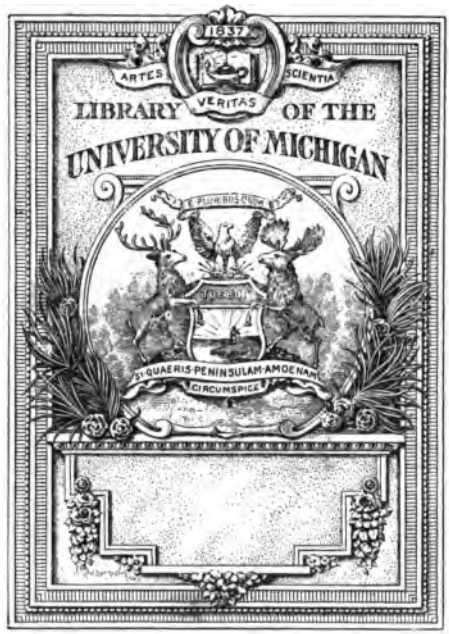


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# TRANSACTIONS

OF THE

# ELEVENTH ANNUAL MEETING

OF THE

# American Gastro-Enterological Association

HELD AT

## Chicago, Illinois

June 1 and 2, 1908

OFFICERS:

PRESIDENT

Julius Friedenwald, Baltimore

VICE-PRESIDENTS

David Edsall, Philadelphia  Wm. Gerry Morgan, Washington

SECRETARY AND TREASURER

Charles D. Aaron, Detroit

COUNCILORS

G. W. McCaskey, Fort Wayne  H. W. Bettmann, Cincinnati
J. P. Sawyer, Cleveland

COMMITTEE ON ADMISSIONS AND ETHICS

S. J. Meltzer, New York  C. G. Stockton, Buffalo
J. Sailer, Philadelphia

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Discussion.

"An Explanation of the Motor Activities of the Alimentary Canal in Terms of the Myenteric Reflex." Walter B. Cannon, Boston.
Discussion.

"Plastic Peritonitis." G. W. McCaskey, Fort Wayne.

"Cholecystitis, with Suggestions for the Prevention of Gallstones." Henry Wald Bettmann, Cincinnati.
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"Intestinal Sand: The Banana One of its Sources." Jesse S. Myer, St. Louis. Jerome E. Cook, St. Louis.
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"A Comparison of the Guiac and Benzidin Tests for Invisible Hemorrhage in Diseases of the Digestive Organs." Franklin B. White, Boston.
Discussion.

"Treatment of Gastric Ulcer." J. W. Bell, Minneapolis.
Discussion.

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W. v. Leube.....Wurzburg, Germ'y.

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F. Glenard.....99 Boulevard HaussmannParis, France.

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I. Adler .....22 East 62nd St.....New York.
Seymour Basch .....14 East 60th St.....New York.
John W. Bell.....1037 Andrus Bldg.....Minneapolis. Minn.
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S. W. Lambert.....130 East 35th St.....New York.
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Morris Manges .....941 Madison Ave.....New York.
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George W. McCaskey...407 W. Main St.....Fort Wayne, Ind.
Frank H. Murdoch.....Empire Bldg.....Pittsburgh, Pa.
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Frank Pfaff .....29 Gloucester Ave..... Boston, Mass.
Edward Quintard.....145 58th St.....New York.
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Bertram W. Sippy.....100 State St.....Chicago, Ill.
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J. Dutton Steele.....40th & Locust Sts.....Philadelphia, Pa.
Charles G. Stockton....436 Franklin St.....Buffalo, N. Y.
Fenton B. Turck .....151 Rush St.....Chicago, Ill.
Franklin W. White.....416 Marlborough Ave...Boston, Mass.

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## Deceased

| | | |
|---|---|---|
| Samuel Fenwick | - | London, England |
| Adolf Kussmaul | - | Heidelberg, Germany |
| Franz Riegel | - - | Giessen, Germany |
| D. D. Stewart | - - | Philadelphia, Pa. |
| J. Dutton Steele | - | Philadelphia, Pa. |

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# CONSTITUTION AND BY-LAWS

OF THE

# AMERICAN GASTRO-ENTEROLOGICAL ASSOCIATION.

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## CONSTITUTION.

ARTICLE 1. This Association shall be known as the American Gastro-Enterological Association.

ARTICLE 2. The object of this Association shall be the promotion of investigation of the normal and pathological conditions of the digestive organs.

ARTICLE 3. Membership in this Association shall be of three kinds; (a) Honorary, (b) Corresponding, (c) Active.

(a) Honorary membership shall be restricted to such as have attained an international reputation by their published works and have scientifically furthered the subject of gastroenterology. Their nomination shall take place at the annual meeting, upon the written suggestion of at least six active members and on the recommendation of the Council of the Association at the next annual meeting. Their elecion shall be by unanimous vote of the members present.

(b) Corresponding membership shall be restricted to foreign scientists in recognition of meritorious work within the scope of the Association. Candidates for such membership shall be proposed by at least six active members and receive the recommendation of the Council at the next annual meeting. Their election shall be by unanimous vote of the members present.

(c) Active membership shall be restricted to American and Canadian investigators and practitioners who have accomplished meritorious work in normal or pathological anatomy or physiology, in medicine or surgery of the digestive canal and its secretory appendages and who enjoy an unimpeachable moral standing in the medical profession. Names of candidates for active membership must be: (1) proposed by two active members who are not members of the Council, such proposal to be submitted to the Committee of Admissions and Ethics, which should report to the Council, as soon as possible; (2) must be recommended by the Council, and (3) must receive a majority of the votes of active members present at the annual meeting of the Association.

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The election of active members shall take place at the annual meeting of the Association and shall be by ballot. It shall be the duty of the Secretary to notify active members of all nominations that are to be submitted to the Association at the annual meeting.

ARTICLE 4. The Officers of the Association shall be a President, two Vice-Presidents, a Secretary and Treasurer, the latter two offices being vested in one; also three specially chosen active members to be known as Councilors, who together with the officers, shall constitute the Council of the Association. The said Councilors shall be elected as follows: One for one year, one for two years, and one for three years.

ARTICLE 5. There shall be a Committee on Admissions and Ethics. It shall consist of the President and the Secretary and of three other members, not members of the Council. These members shall be elected at the annual meeting at which this Amendment shall be adopted for the following terms: one for three years, one for two years, and one for one year. At each subsequent annual meeting one member shall be elected for the term of three years to fill the annual vacancy. No member of the Committee shall be eligible for re-election until after one year shall have elapsed from the end of his term of service. It shall be the duties of the Committee on Admissions and Ethics to examine the merits of a candidate, to investigate any charges made against a member, and to report the results of the examination and investigation to the Council in writing in the shortest possible time. It shall also be the duty of this Committee to study the active work in science and practice of gastroenterology accomplished in this country and Canada and to invite the meritorious workers to join the Association.

ARTICLE 6. The elections of Officers, Councilors and of the members of the Committee on Admissions and Ethics shall take place at the annual meeting and shall be by ballot.

ARTICLE 7. Vacancies in the offices occurring in the interval between the annual sessions shall be filled temporarily by the Council.

ARTICLE 8. The annual meeting of the Association shall be held at a time and place to be decided by the Council.

ARTICLE 9. The President shall be the Chairman of the Council.

ARTICLE 10. There shall be annually two meetings of the Council; one shall take place at the call of the President, shortly before the annual meeting of the Association; the other shall take place at least four weeks previous to the annual meeting. It shall be within the discretion of the President to conduct this latter meeting by correspondence

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ARTICLE 11. The Council shall manage the affairs of the Association in accordance with the Constitution and By-Laws, and its minutes shall be reported to the Association at the annual meeting.

ARTICLE 12. This Constitution may be amended by a two-thirds vote of all the active members at any annual meeting, provided that notice of proposed amendments has been given in writing to all the active members of the Association by the Secretary, and provided further that such proposed amendments shall have been submitted to the Council and held over for one year.

ARTICLE 13. Any member failing to attend three consecutive annual meetings without an excuse acceptable to the Council shall be dropped from the roll. The secretary however, shall be required to call the attention of a delinquent member to the facts in his case previous to the third meeting.

ARTICLE 14. This Association adopts the Code of Ethics of the American Medical Association. Charges of advertising, of publishing knowingly false scientific statements, of actions unbecoming a gentleman and a high standing physician, etc., shall be investigated by the Committee on Admissions and Ethics. The accused shall have liberal opportunities to clear himself of the accusation. The Committee shall report its findings to the Council and on the recommendation of this body an offending member may be expelled by a three-fourths vote of those present at the annual meeting.

## BY-LAWS.

ARTICLE 1. The President and Vice-President shall discharge such duties as are implied by their respective offices. The President shall preside at all sessions of both Council and Association.

ARTICLE 2. The Secretary shall attend to the usual clerical duties of the Council and Association. As Treasurer, he shall keep a record of the payment and arrearages of dues, and report on both at the annual meeting.

ARTICLE 3. The Council shall report its transactions to the annual meeting of the Association. It shall superintend the publication of scientific papers, but shall not appropriate for such printing an amount exceeding the sum of $100, without the vote of the Association. The order of business shall be arranged by the Council before the annual meeting. It shall pass upon the eligibility of candidates for membership.

ARTICLE 4. The yearly dues of active members shall be five dollars, payable in advance. Any members whose subscription shall be in arrears more than two years shall be

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reminded of the fact by the Treasurer, in writing; in event that payment be not then made he may, on vote of the Council, be dropped from the roll of the Association. It shall be the duty of the Treasurer to report all members who are in arrears to the Council.

ARTICLE 5. When sufficient money is in the treasury the membership dues may be omitted when decided by the Council.

ARTICLE 6. These By-Laws may be amended, repealed or suspended by a two-thirds vote of the members present at any meeting of the Association.

ARTICLE 7. The quorum of the Association for the transaction of business, but not for the reading of papers, shall consist of seven active members.

ARTICLE 8. All titles of papers submitted for reading at the annual meeting shall be sent to the Secretary not later than four weeks before the date of the meeting.

ARTICLLE 9. A typewritten abstract of not over three hundred words, of every paper to be read, must be sent to the Secretary at least four weeks before the annual meeting. It shall be the duty of the Secretary to send to each member of the Association a complete list of the papers to be read at the annual meeting, with their full titles, at least two weeks before the annual meeting.

ARTICLE 10. Papers submitted to be read before the Association shall not have been previously published or read elsewhere. Papers shall not exceed the limit of 15 minutes without the consent of the majority of members attending.

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*Reprinted from the New York Medical Journal for September 19, 1908.*

# ISCHOCHYMIA.*

By Frank Hall Murdoch, M. D.,
Pittsburgh, Pa.

Ischochymia is an affection characterized by the constant presence of food in the stomach, even in the fasting state (Einhorn). It may be acute or chronic. Whether acute ischochymia or acute dilatation of the stomach, as it is termed by Boaz, Hunter, and others, is due to a paralysis of the gastric muscles, or to a spasmodic contraction of the pylorus, or to both, is as yet undecided. It is usually brought on by some gross error in diet, though it occasionally follows chloroform anæsthesia. Out of sixty-four cases known, forty-seven proved fatal. Of the total number of cases, twenty-nine followed chloroform anæsthesia, and in eleven of these the operation had not involved the abdomen, but was at points remote from it (Neck).

The chronic form is caused (1) by mechanical obstruction of the pylorus, (2) by absolute or relative weakness of the expulsive forces—in other words, atonic conditions of the muscularis. The mechanical factors which lead to stenosis or occlusion of the pylorus are either situated in the wall of the stomach itself or extend to it from without. The most frequent causes of the former are carcinoma and cicatricial contraction from an ulcer situated near the pylorus, or spasmodic contraction of the pylorus from the same cause. There are cases too in which hypersecretion of gastric juice has so

*Presented at a meeting of the American Gastroenterological Association at Chicago, June 1, 1908.

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irritated the mucus membrane of the stomach as to cause spasmodic contraction of the pylorus with temporary stagnation of food in the stomach, and should this condition continue long enough, it may finally lead to muscular hypertrophy.

The causes situated external to the stomach which may produce stenosis or occlusion of the pylorus are tumors arising from the pancreas, the omentum, the retroperitoneal glands or the liver, adhesions of the pylorus to neighboring organs, or cicatricial bands, which make traction or pressure on the pylorus. Bartels was the first to call attention to the joint occurrence of wandering right kidney and dilatation of the stomach, but Oser, Nothnagel, Leube, and Ewald believe that no causal relation exists in the majority of cases, and Kutner has shown that in many cases of so called dilatation with floating kidney, there is no dilatation, but either a megalogastria or a gastroptosis, which has led to erroneous conclusions (1).

Stenosis of the pylorus is always associated with hypertrophy of the muscular wall of the stomach, just as an aortic or mitral stenosis is accompanied by hypertrophy and dilatation of that portion of the heart situated behind the obstruction. Also in the later stages of advanced dilatation, the musculature, though hypertrophied, may become so weakened that all peristaltic movements may cease (2), just as rupture of compensation occurs in long standing cases of dilatation of the heart due to obstruction at one of its openings.

Most authorities distinguish two degrees of ischochymia. In the morning if food is found in the stomach which had been taken the previous evening, this is considered to be a high degree of ischochymia. If, on the other hand, the stomach is found to empty itself during the night, but con-



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tains particles of food seven hours after a test meal, this is said to be a mild degree of ischochymia. Ischochymia due to atony of the stomach walls is comparatively rare, and an exact diagnosis is at times very difficult. If we have a case of ischochymia, where a thickening of the pylorus can be palpated, and also where peristaltic restlessness can be seen, then the case is clear; but if neither of these signs is present it is not easy to say whether we have before us a case of obstruction of the pylorus of long standing with resultant loss of peristaltic movements of the stomach, or whether we have such a loss of motility from atony of the gastric musculature as renders the stomach inadequate to transport its contents through a normal pylorus.

Usually in ischochymia resulting from stenosis of the pylorus, only the coarser particles of food are found in the stomach in the morning before the patient has eaten anything, the finer particles and the liquid contents having passed into the intestines. On the other hand, where stagnation of food is due to atony of the gastric musculature, the coarser particles of food will pass through the pylorus and only a small quantity of the finer particles mixed with liquid chyme will be found in the stomach in the morning before the patient has taken any food. In the treatment of ischochymia due to mechanical obstruction of the pylorus, surgical interference is demanded if the obstruction is due to malign stenosis, to benign stenosis of high degree which will not yield to medical treatment, to adhesions of the pylorus to neighboring organs, to cicatricial bands, or to tumors which by pressure obstruct the outlet of the stomach. Formerly operation was considered necessary in all cases of benign stenosis of the pylorus of whatever degree, but now we know that such is not the case, for under proper medical



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treatment, including diet and lavage, many patients entirely recover. If we have a patient who has a stenosis of the pylorus of such degree that solid food will not pass out of the stomach in the normal time, but will pass out in twelve or fourteen hours, we can allow that patient two meals of solid food each day, one in the morning, the other in the evening, and direct that liquid food be given between meals in sufficient quantity to make up the necessary number of calories. If the stenosis is of such degree that a test meal of solid food remains in the stomach for a longer time than twelve or fourteen hours, then liquid food only should be allowed for a time, the stomach meanwhile being washed out every morning before the patient has taken any food. So long as the patient can, under this treatment, maintain his strength and weight, and is willing to live in this way, operation should not be urged, because there is always a hope of complete recovery without surgical intervention, and should the patient begin to lose ground in spite of these measures, an operation can be done at any time. Stenosis of the pylorus which occurs in wasted infants, at least that due to spasm, also seems quite amenable to medical treatment. Bloch has recently reported twelve cases. The first six infants were treated with gastroenterostomy and four died. The last six were treated by medical means and recovered. In the fatal cases the pylorus was always found closely contracted, but the evidence, he thinks, tends to show that when this spasmodic contraction is overcome the normal lumen of the pylorus is permanently restored (3).

Robert Hutchinson also reports nine typical cases of congenital stenosis of the pylorus seen by him during the winter of 1905 and 1906, all of which recovered under medical treatment. In two of the



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cases the condition seemed at one time to be so desperate that operation was advised, but was not performed because the parents refused to sanction it; yet both children ultimately got well. He therefore states his position as follows: (1) Operation is never justifiable as soon as the diagnosis of congenital pyloric stenosis has been made. (2) One can never be sure that medical treatment is going to fail until the condition of the child is already so bad that the chance of recovery after operation is almost nil. He believes with Bloch, that the stenosis in these cases is the result of spasm which leads to a secondary hypertrophy of the pylorus, and that this hypertrophy disappears as the spasm passes off (4). Miller and Wilcox (5) likewise believe that the medical treatment yields the best results, and are of the opinion that those children who die under medical treatment die with diarrhœa, because the intestine has become too atrophic to deal with the food which passes into it when the pyloric spasm has been relaxed. As additional evidence showing what may be done by medical means for the relief of benign stenosis of the pylorus in adults, I wish to report the following cases. In one case the stenosis followed the healing of a chronic gastric ulcer; in the other case the pathogenesis was obscure:

CASE I.—On October 24, 1902, Miss H. N., aged twenty-four, consulted me and gave the following history: In March, 1901, she began having pain in the epigastric region immediately after meals, with nausea but no vomiting. This attack lasted eight months, or until January, 1902. During the winter and spring of 1902 she enoyed good health, excepting that she did not feel very strong. In July of the same year she had an attack of cholera morbus, and has had pain in the epigastrium ten or fifteen minutes after meals ever since.

Present condition: Pain soon after meals made worse by moving about, nausea but no vomiting. Often had a bowel movement after a meal, bad taste after eating, appetite good, but never experienced a sense of having had enough



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food, felt sleepy during the day, but did not sleep well at night, bowels rather constipated; had lost thirteen pounds in weight, now weighed one hundred and ten pounds.

Examination: Heart, lungs, and liver normal. Stomach splashing to navel, right kidney in third degree of displacement, one tender circumscribed spot, two inches above the navel in median line, also a tender spot in the back to the left of the lower dorsal vertebra. Examination of the stomach content, taken an hour after Ewald's test meal, showed that free hydrochloric acid was absent, total acidity 60. Urine was 1.018 specific gravity and contained neither sugar nor albumin.

Treatment: Rest in bed, liquid food, principally buttermilk, and silver nitrate in pill form.

This patient remained in bed three weeks and lived on liquid food for three months, at the end of which time she was permitted three small meals of solid food each day with liquids between. At this time I also made a second examination of the stomach content after an Ewald test meal and found free hydrochloric acid, + 44, total acidity 64.

In November, 1903, she complained of pelvic pain, and Dr. Werder found that her uterus was retroverted and fitted her with a suitable pessary, which gave her relief.

In July, 1904, a year and eight months after I first saw her and fifteen months after commencing to take solid food, she began to suffer from a stenosis of the pylorus, due evidently to contraction or spasm of the tissues at the site of the ulcer, and in spite of the usual treatment the ischochymia persisted for eleven months, or until June, 1905. The stomach then emptied itself normally for six months, or until January, 1906, when the ischochymia again appearing, an operation was strongly advised, but the patient preferred to go on with medical treatment as long as possible; and this attack also yielded, for in June, 1906, she wrote that she had taken a test meal of beefsteak, potatoes, bread, and butter, and on washing out the stomach seven hours afterwards, had found it entirely empty. In February of this year Dr. J. B. Neale, her family physician, informed me that the patient's health was good and that there had been no return of the stenosis.

In regard to the frequency with which stenosis of the pylorus occurs as a result of chronic gastric ulcer, Brinton has computed that severe stenosis occurs in one out of every two hundred cases, and



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Fenwick believes that the pylorus becomes partially occluded in sixteen to twenty per cent. of *all* cases; but that in only about two per cent. of these is the stenosis extreme. The case I have related is one of thirty-two cases of chronic gastric ulcer previously reported, and the only one in which stenosis of the pylorus occurred, being 3.1 per cent. (6).

CASE II.—On July 11, 1904, Mr. C., aged sixty-two, bookkeeper, was referred to me by Dr. R. W. Stewart, who had diagnosticated stenosis of the pylorus, but who did not wish to operate if he could possibly avoid it. The history of the case is as follows: Two years ago he began to be troubled with bloating and belching coming on soon after meals, and also distress in the epigastrium about an hour before each meal, which was relieved by eating. He also suffered from severe attacks of pain in the abdomen, which came on about 4 o'clock in the morning. He had never taken morphine to relieve these pains, but was in the habit of drinking hot water and applying a mustard plaster to obtain relief. He had lost twenty-five pounds in weight, and felt weak and discouraged. His appetite was good, his bowels regular, and he slept well when free from attacks of pain. Inflation of the stomach showed that its lower border extended three and one half inches below the umbilicus. Free hydrochloric acid was present in normal amount. The specific gravity of the urine was 1.010, and it contained neither sugar nor albumin. He took a test meal in the evening, and the next morning before he had eaten anything I washed out his stomach and found part of the food he had taken the previous evening, together with numerous berry seeds he had eaten the day before. Lavage was practised every morning after this and berry seeds appeared in the wash water until the 15th inst., that is, four days after they had entered the stomach. In addition to lavage the treatment consisted in allowing the patient only liquid food, and the method proved so satisfactory that on December 6, 1905, about five months after I had first seen him, he had gained nineteen pounds in weight and felt strong and well. He was then taking two meals of solid food a day, one in the morning and the other in the evening, with liquids between to make up the necessary number of calories. He occasionally washed out his stomach in the morning, and always found it empty. I saw this patient in January, 1906, a year and a half after



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he first consulted me, and he was then in good health; I also heard directly from him three weeks ago, and he was still in good health and so far had not required surgical aid.

There is no doubt that gastroenterostomy would be the ideal treatment for all cases of benign stenosis of the pylorus if it were entirely free from danger, but so long as even a small percentage of patients die as a result of this operation it is the duty of the physician to employ every available means for the patient's relief before advising surgical intervention.

REFERENCES.

1. Ewald. *Diseases of the Stomach,* p. 275.
2. Reigel. *Diseases of the Stomach,* p. 418.
3. Bloch. *Jahrbuch für Kinderheilkunde,* lxv, No. 4, p. 393-518.
4. *International Medical Review,* p. 14.
5. Miller and Wilcox. *Lancet,* December 14, 1907, p. 1670.
6. Murdoch. *American Medicine,* September 12, 1903.

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## DISCUSSION.

Dr. G. W. McCaskey, Fort Wayne: I feel inclined to question the correctness of the limit of seven hours as the time in which a healthy stomach should empty itself, and beyond which it should be labeled a case of ischochymia. I do not know just what the limit should be, but certainly many stomachs with a slightly weakened musculature will take longer—possibly eight or nine hours—without being cases of ischochymia. I do not think we have data at present sufficient to decide the question.

Another point I want to refer to is the cause of ischochymia. In a large proportion of cases it is no doubt due to stenosis. The author of the paper stated it was undecided whether it could be due simply to weakness of the musculature of the stomach. I have been convinced for years that in many cases in which the food remains in the stomach long enough to constitute a pathological condition which will justify the diagnosis of ischochymia, the presence of an actual stenosis is pure presumption unless the condition has been demonstrated by surgical interference or at autopsy.

Dr. Max Einhorn, New York: I am inclined to agree with Dr. McCaskey that the name ischochymia should be restricted to those cases where the stomach has not emptied itself in the morning, and that those cases in which food is present six or seven or eight hours after a meal should be regarded as cases of atony of the stomach. The chief problem that confronts us is whether or not there is pyloric stenosis. This is often very difficult to decide, as I believe that ischochymia may result from extreme weakness of the musculature of the stomach. I have tried to differentiate between this condition of muscular weakness and actual stenosis by giving the patient a test meal containing rice, which will pass only if the pyloric opening is sufficiently patent. When you find that the coarse particles of food have found their way through the pylorus while the stomach still contains the finer particles, it is fairly good evidence that we are dealing with muscular insufficiency rather than stenosis of the pylorus.

There are cases of stenosis of the pylorus that can be successfully treated medicinally. We may have to deal with an inflammatory condition about the pylorus, with edema——in other words, with a temporary stenosis, and with a subsidence of this, there is a return to normal conditions. This may be a predisposing factor in the causation of a greater or lesser degree of permanent stenosis of the pylorus.

Dr. Franklin W. White, Boston: I do not agree with Dr. Murdoch that we can rely upon medical means as a cure in any considerable proportion of these cases of obstructed pylorus. If we confine our definition of ischo-

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chymia to cases in which there is a food stasis of twelve hours or longer, there are relatively few that can be cured by medical treatment alone; the probabilities are then that we are dealing with an obstructive condition, and most of these cases will eventually go to the surgeon.

There is another point in regard to which I differ from the opinion expressed by the author of the paper. I do not believe that we can make the distinction between the two kinds of benign stasis, atonic and obstructive by the character of the gastric contents. In both of the classes of cases mentioned, the stomach contents are apt to be of the same character.

Dr. Henry Wald Bettmann, Cincinnati: In order to prevent this from drifting into an academic discussion, I should like to call attention to the fact that it is not necessary that we should make minute clinical distinctions in all of these cases. The important point is to determine whether the stomach is able to propel the food through the pylorus in sufficient amount to properly nourish the patient. The greatest single advance that has been made in the treatment of ischochymia was that of Kussmaul, in 1868, when he introduced the stomach tube into clinical medicine, and he subsequently reported a number of cases of very advanced stenosis of the pylorus which were cured by gastric lavage. Most of them were so far advanced that today they would doubtless be turned over to the surgeon for relief, and Kussmaul, in his original article, expressed the hope that in the future some surgeon would be found bold enough to operate in such cases.

I do not agree with the statement made by one of the speakers that patients who suffer from a 12-hour stasis of food in the stomach are not amenable to medical treatment: Kussmaul's results are a contravention of that statement, and cases have been published since then which were cured by medical means after even a twenty-four hour stasis. Dr. Einhorn read a paper on this subject some years ago in which he reported some very extreme cases that recovered under medical treatment. The first thing to do in the treatment of this condition is to try to learn how much of the obstruction is due to temporary causes, such as edema or spasm. It may require several weeks of careful observation to determine the character and degree of obstruction.

Dr. Alfred D. Kohn, Chicago: I would like to say a few words on the surgical aspect of this question. In the first place, it has been the experience of a good many surgeons and internists that gastroenterostomy for benign stenosis, so-called, was done rather indiscriminately, and was frequently followed by fatal ulcers of the jejunum. We should carefully select our cases before advocating gastroenterostomy, and distinguish between those in which

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there is hyperchlorhydria and those in which there is not. In cases were hyperchlorhydria exists and an immediate operation is absolutely essential, it would be advisable to resort to a preliminary jejunostomy until the urgent symptoms have cleared up.

Dr. John A. Lichty, Pittsburgh: I think Dr. Bettman's statement as to ischochymia of the first or second degree carries with it a distinction that it is not always practicable to make. Our only practical guide is the nutrition of the patient. Are we able or not to keep the patient in good health? If we are not able to do this by dietetic and medical means, then we must look elsewhere for a remedy, and in determining the advisability or non-advisability of surgical intervention we cannot depend absolutely on the fact that remnants of food are present in the stomach after so or so many hours.

In the first case reported in Dr. Murdoch's paper, the first examination of the stomach contents showed an absence of free hydrochloric acid, but subsequently it was present in considerable quantity. I know that Dr. Murdoch is a very careful observer, and yet it seems to me that mistakes are possible, even with very frequent examinations, if we depend on the analysis of the stomach contents alone. Our safest guide is the nutrition of the patient.

My experience with gastroenterostomy is these cases has been very satisfactory. The mortality in my cases has been *nil.* And yet though the mortality of the operation is very low, I do not believe that gasroenterostomy will stand the final test in these cases, for it will in time be supplanted by a more satisfactory procedure. In corroboration of this, I will cite the figures of the Mayo brothers, who in one of their earlier reports, 1906, record 2,750 abdominal operations, including about 7,1 gastroenterostomies. In their recent report, 1907, they record only 55 gastroenterostomies, in 3215 abdominal operations I am convinced that in the future the operation will be done less frequently than in the past. The operation that should be done in these cases is pyloroplasty, and when the surgeons become more familiar with the technique of that operation, I believe the death rate following it will be no higher than that of gastroenterostomy, and the results will be far more satisfactory.

Very recently I saw a case of benign stenosis in which it was agreed upon between the surgeon and myself that a pyloroplasty should be done, but after opening the abdomen though the conditions were as we had diagnosed, he decided to do a gastroenterostomy instead. He simply did not feel himself sufficiently familiar with the technique of pyloroplasty.

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Dr. J. C. Johnson, Atlanta: I think there is something distinctive about ischochymia which cannot be altogether explained by the degree of the stenosis or the degree of impairment of the gastric musculature, and we should always be very guarded in making our diagnosis. I recall a case which I had operated on only a few weeks ago, after the patient had been under observation and systematic treatment for several weeks. When the abdomen was opened, the only abnormal condition found was a little band of adventitious tissue running along the curvature of the duodenum, and really not constricting the pylorus at all. In fact, nothing was found to account for the pronounced symptoms from which the patient had suffered. The stomach was suspended slightly, the abdomen was closed, and for several days following the operation the patient seemed to be doing very well; then he gradually failed, and died within a fortnight. Why he died or where the seat of the trouble was I do not know. I do not believe he was benefited by the operation, and I do not think that the band of adventitious tissue that was found had anything to do with his symptoms. The greater curvature of the stomach seemed to be at the umbilicus, and there was apparantly no marked atony.

Along this line it occurs to me that too little attention has been paid to the mechanical action of the duodenum, not only in its relation to the gall bladder, but also in its relation to benign and malignant conditions of the pylorus. I believe the profession has neglected that phase of the subject too much, and that we can explain many of the persistent and aggravated conditions of the stomach by directing more attention to the condition of the duodenum and its close relation to the gall bladder. In the case I have related I believe that the real cause of the patient's trouble could have been found below the point where we looked for it.

Dr. John P. Sawyer, Cleveland: As a matter of some interest, I would like to allude to a case which came under my observation the present year, and which bears upon the observation of Dr. Einhorn that mechanical obstruction need not be present in connection with ischochymia. The patient was a young woman upon whom a pyloroplasty had been done about a year ago, followed, six months later, by gastroenterostomy. Both operations were done by competent men, but in spite of them the patient's symptoms failed to improve until she was placed under medical care and attention was directed to her general nervous condition.

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*Reprinted from the New York Medical Journal for June 20, 1908.*

# A NEW METHOD OF ESTIMATING THE PERMEABILITY OF THE PYLORUS AND AN ATTEMPT AT TESTING THE PANCREATIC FUNCTION DIRECTLY.*

By Max Einhorn, M. D.,
New York,
Professor of Internal Medicine at the Postgraduate Medical School.

## *I.—Permeability of the Pylorus.*

The methods ordinarily used for estimating the permeability of the pylorus are based principally upon examinations of the motor function, or rather prochoresis, of the stomach, as, for instance, the oil test of Klemperer and the examination for food remnants of the day previous in the fasting condition. Neither test decides whether the trouble is caused by abnormal weakness of the gastric musculature or by a narrowing of the pylorus. The rice test meal recommended by myself and the currant test of Strauss take the condition of the pylorus a little more into account. The rice test will, however, be positive only in advanced cases, and the currant test suffers from the drawback that frequently the currants will not pass the stomach tube.

The direct introduction of rubber tubes into the pylorus has been tried by Hemmeter and Kuhn, but not with very marked success.

The idea presented itself of having beads of different sizes attached to a silk thread and having them swallowed in order to see whether they pass the pylorus or not. In normal conditions they will pass; in stenosis they will remain in the stomach.

*Read before the meeting of the American Gastroenterological Association, held at Chicago, Ill., on June 1, 1908.

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As the length of the thread in itself is not a sufficient guide to decide whether the bead was in the duodenum or not we must look for a different indicator for this purpose. In the beginning I used beads coated with mutton tallow, later beads filled

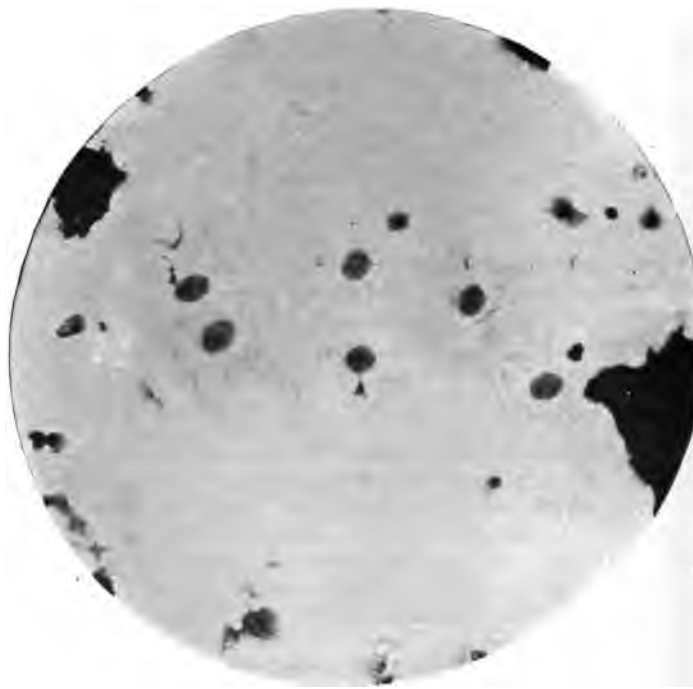

FIG. 1.—Smear of a piece of thymus (proximal piece) which had been kept in patient McK.'s stomach for five and a half hours (May 4, 1908). The nuclei are unchanged and visible as regularly oval or rounded bodies.

with methylene blue and coated with mutton tallow. In as far as the fat is dissolved mainly in the duodenum, a green or blue color of the urine would show that the bead had already passed the pylorus. This usually occurs in from three to five hours. If



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we then withdraw the bead we will find that it is empty, i. e., contains neither fat nor methylene blue. In order to be sure, however, that the process (disappearance of fat and methylene blue) really occurred in the duodenum and not in the

FIG. 2.—Smear of a piece of thymus (distal piece) which had been kept in patient McK.'s digestive tract for five and a half hours (May 4, 1908). The nuclei have almost all disappeared, and broken up débris are visible.

stomach, I tied another similar bead for control purposes to the thread at a distance of fifty centimetres from the lips. This bead can only remain in the stomach, whereas the original bead was tied



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at a distance of seventy-five centimetres from the lips, and could thus pass the pylorus and travel for a distance in the duodenum. If, therefore, the distant bead is empty, whereas the proximal bead is still filled, it would prove that the lower bead had passed the pylorus.

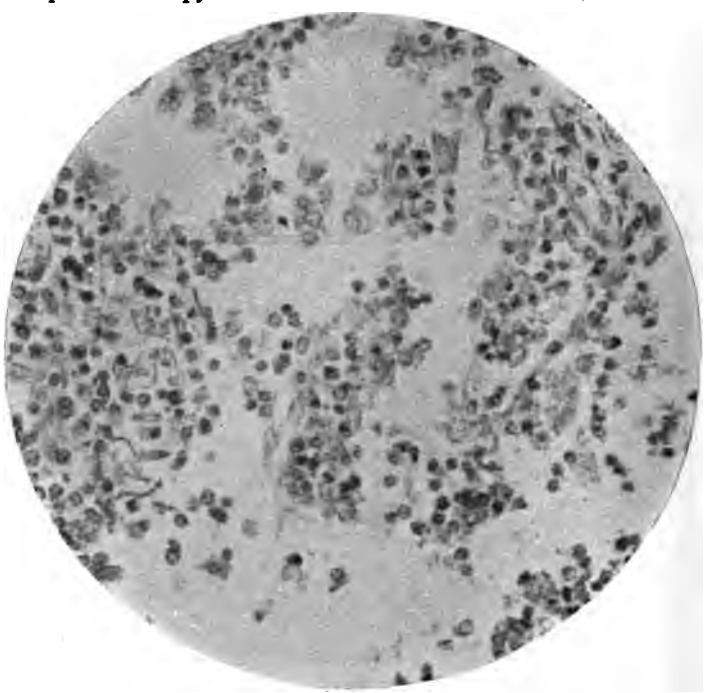

FIG. 3.—Section of a thymus piece (proximal piece), which had been kept in patient O.'s stomach for six hours (April 20, 1908). The nuclei are visible as rounded or slightly oval bodies of a regular shape.

In some cases of pyloric stenosis both beads remained full.

In doing this test on a large number of patients without pyloric stenosis at the German Hospital, it



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was shown that frequently the stomach bead was empty, i. e., the fat can disappear from the bead in the stomach (perhaps mechanically), and methylene blue can thus be liberated. If both beads are empty we can naturally not say whether the lower bead passed the pylorus or not.

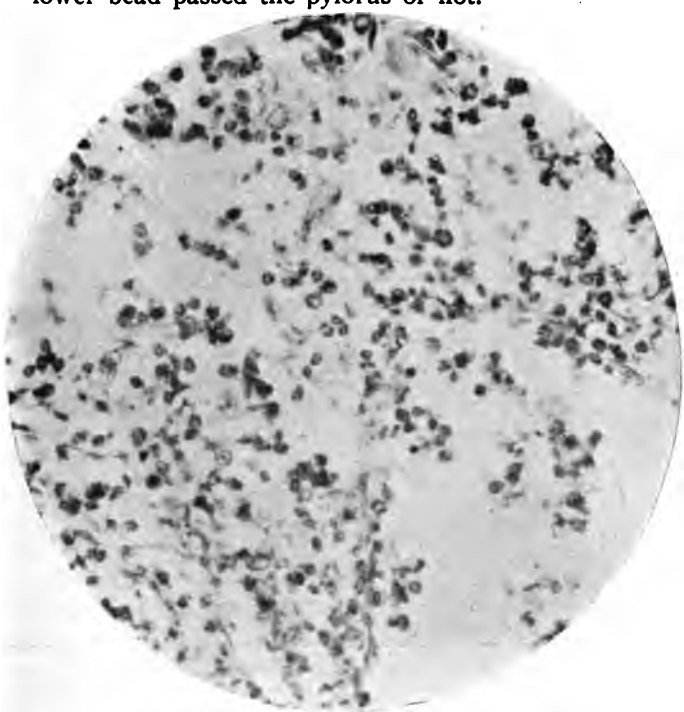

FIG. 4.—Sectior of a piece of thymus (distal piece), which had been kept in patient O.'s digestive tract for six hours (April 20, 1908). The nuclei are partly destroyed. In some places they show distinctly irregular shapes.

It was therefore necessary to look for other indicators. At first I used pieces of thymus in gauze and tied to the bead. In the small intestine the



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nuclei will disappear, whereas in the stomach they are not changed. If we allow the beads with the thymus for four to six hours to remain in the digestive tract, we find in most cases that the result will be as indicated before. (See Figs. 1 to 4.)[1] If, however, we leave the beads in the intestinal tract for a longer time, as over night (for about eleven to twelve hours), it happens occasionally that the nuclei will also disappear in the stomach.

Why this should happen, whether there is regurgitation of the pancreatic juice into the stomach, or whether it is due to other circumstances, I

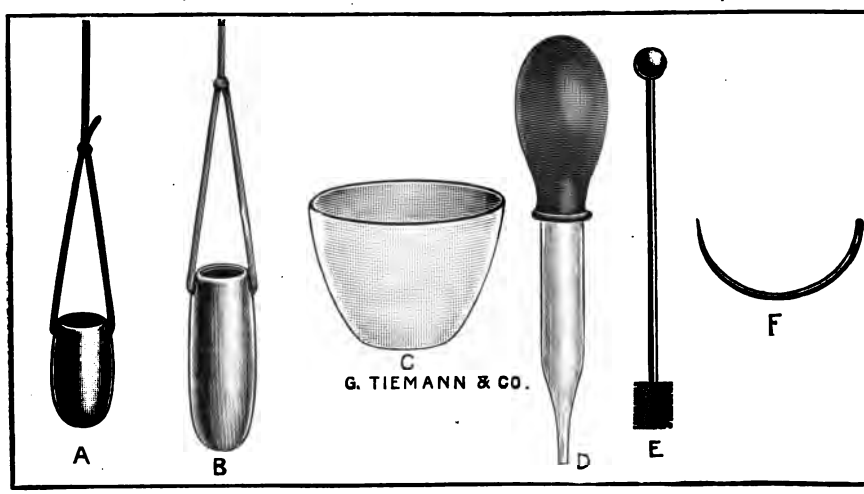


FIG. 5.—The duodenal bucket and its accessories. A, small si ze; B, larger size; C, porcelain dish; D, aspirating pipette; E, brush; F, needle.

am at present unable to state. At all events, the thymus was not sufficiently reliable for our purpose.

Instead of thymus I used pieces of agar that had been saturated with tincture of litmus and later with dimethylamidoazobenzol. They were placed

[1]I am greatly indebted to Miss Katharine Foot and Miss E. C. Strobell for taking these excellent microscopical photographs.



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FIG. 6.—X ray photograph of patient H.'s stomach, very soon after the ingestion of thirty grammes of bismuth subnitrate. A, stomach.



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may, of course, be utilized for testing the pancreatic function. I proceed as described before, and have the result in five hours.

Instead of observing the change in test substances due to the action of the pancreatic juice it would naturally be better to get the juice directly. Boas tried this by introducing a tube into the empty stomach, massaging the region of the liver, and then obtaining the gastric contents. In some cases Boas succeeded in demonstrating pancreatic juice in this fluid. This method is, however, successful only in a fraction of the cases. The same may be said of the methods of Hemmeter and Kuhn, to obtain the juice by direct sounding of the duodenum.

On the same principle as the stomach bucket I have constructed a much smaller duodenal bucket (Fig. 5). If we have the patient swallow this bucket on a thread for a distance of seventy-five centimetres from the lips then we can often obtain duodenal chyme.

I proceed as follows: The duodenal bucket, tied to a long string of braided silk, with a mark at seventy-five centimetres, is placed in a gelatin capsule and given about one hour after a small meal. It is left in the digestive tract for three hours without taking any more food. The thread is tied to the ear or fastened in another manner, so that it cannot go beyond the seventy-five centimetre mark. After three hours the thread is slowly drawn up. In many cases we could feel a slight resistance when the bucket passed the pylorus, the cardiac end usually offering no resistance. At the entrance of the œsophagus the resistance is overcome by having patient swallow once before withdrawing the bucket. It is still better to have patient swallow the bucket before retiring and withdraw it in the morning in the fasting condition.

Usually the bucket returns filled. The contents may be removed by means of a pipette and placed



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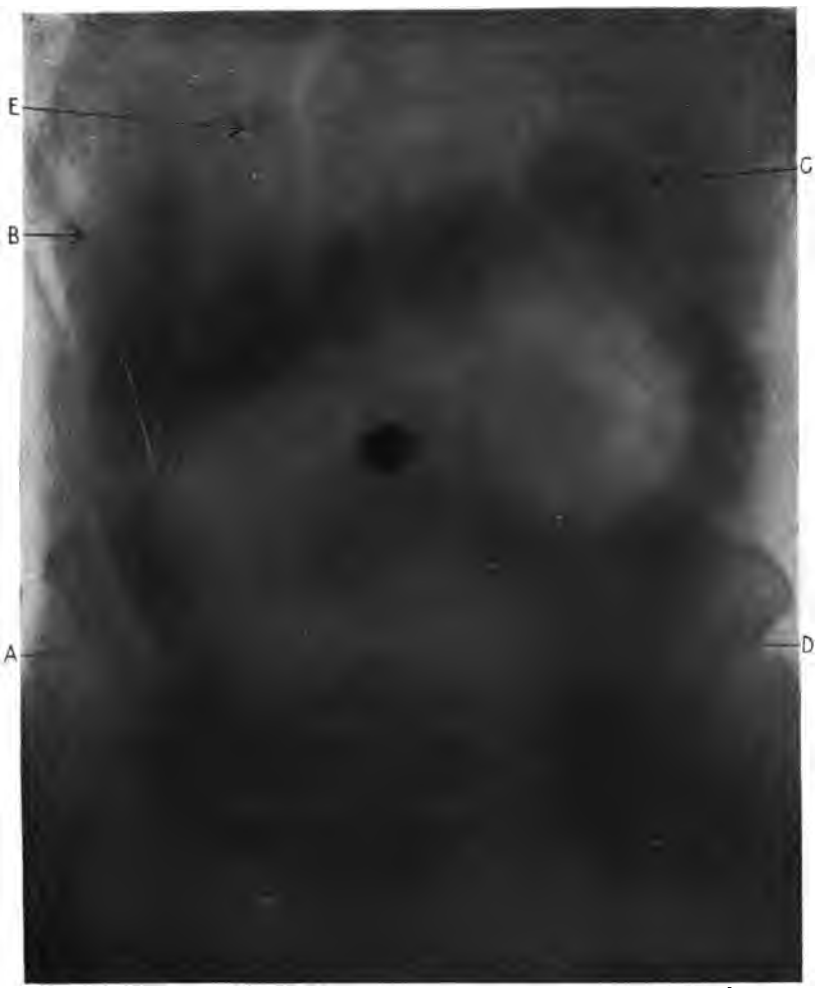


FIG. 8.—Same as Fig. 7, taken a few minutes later after injecting thirty grammes of bismuth subnitrate into the bowel. The outlines of the colon are more distinct. There is marked angulation of the sigmoid flexure. The bucket is seen in the duodenum in a slightly different position from Fig. 7. A, cæcum; B, hepatic flexure; C, splenic flexure; D, sigmoid flexure and its angulation; E, duodenal bucket. (Einhorn, Permeability of Pylorus, etc.)



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in a small porcelain dish. The contents usually look yellowish (owing to the admixture of bile), and yield a neutral or faintly acid reaction without the presence of free hydrochloric acid.

Only in one case of grave hyperchlorhydria, after an old ulcer of the stomach, free hydrochloric acid was found in the yellowish fluid. In this case the string showed a distinctly brownish coloration at the portion 52 to 64 cm., while the rest was not colored. The brown part gave positive reaction for blood. The colored string marked most probably the position of the ulcer in the pylorus and duodenum.

That the duodenal bucket really gets into the duodenum may be seen, first, from the contents, secondly, from a Röntgen ray picture taken before removing the bucket. Such an x ray picture from patient H., three and a half hours after swallowing the bucket is here reproduced. (Figs. 6, 7, and 8.)[3] The duodenal bucket can, of course, also be used for testing the permeability of the pylorus. For when it returns with the duodenal contents it certainly must have passed the pylorus. The tests described here, however, will be of benefit principally in those cases in which there is any doubt whether regurgitation has taken place from the duodenum into the stomach.

20 East Sixty-third Street.

[3]Dr. L. G. Cole was kind enough to take these x ray photographs.



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## DISCUSSION.

Dr. Fenton B. Turck, Chicago: We have been very much entertained and instructed by the gratifying presentation made by Dr. Einhorn, and his efforts to improve our present diagnostic methods in this field. Dr. Einhorn's work in the past, which has been amply confirmed, only makes this presentation all the more valuable and acceptable.

Attempts to explore and determine the condition of the stomach and duodenum with the aid of capsules have proved of the greatest service to me in my work, and for many years I have worked along lines similar to those outlined in this present paper. In 1898 I showed a capsule devised for the purpose of examining the stomach; instead of a bucket, I used a capillary rubber tube, folded in a gelatine capsule at the end of which there were two beads, which were attached for the purpose of carrying it. Through this capillary tube I inserted small strips of cloth or paper impregnated with dimethyl-orange and litmus, and we found, upon withdrawing it, that we could frequently note a change in the character of the contents of the tube, both in the stomach and duodenum.

The use of thymus and fat by Dr. Einhorn in his experiments, and their recovery from the stomach and duodenum after certain periods of time, is certainly very ingenious, and will doubtless prove of much practical value.

In regard to sounding the duodenum, I made a report of my experiments and observation in that connection before the International Congress at Rome, in 1894, and since the discovery of the X-Rays I have presented photographs demonstrating the passage of a sound through the pyloric orifice into the duodenum. Those observations are also on record. The method I have used in studying obstructive conditions of the pylorus was to take a small quantity of bran, which was stained with di-methyl and orange mixed with litmus and also bran stained with hematoxylin, and then to determine how long this remains in the stomach, at the same time examining the feces. The bran was given in the course of a meal. The same experiments were repeated after the stomach had been exercised with air and the differences in reaction and time noted.

Dr. G. W. McCaskey. Fort Wayne: In connection with Dr. Einhorn's paper and demonstration, I want to call attention to what I believe to be a reliable observation in regard to the presence of steapsin under normal conditions in the gastric contents. In v Noorden's work on *Metabolism* it is said that the gastric contents contain steapsin, and if that is so, the question naturally arises

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whether, in the tests made by Dr. Einhorn, the fat may not sometimes be digested in the stomach and some of the methlyene blue liberated there?

In regard to the tests with thymus gland, while a positive result would be of great value, a negative result would be of no value in determining the absence of pancreatic disease. We may have a carcinoma involving one-half of the pancreas, and still have enough pancreatic juice left to carry on digestion.

I consider Dr. Einhorn's observations of the greatest value, and they will no doubt prove very helpful to us.

Dr. Charles D. Aaron, Detroit: I have thought that the work of Volhard, in connection with his determination of steapsin in the normal gastric contents, was open to doubt from the fact that many investigators have reported that its presence there was due to the regurgitation of pancreatic juice from the duodenum back into the stomach.

Dr. Walter B. Cannon, Boston: Volhard, in his recent work on the fat-splitting ferment of the stomach, speaks of it as affecting only the emulsified fats. It would therefore not affect the form used by Dr. Einhorn in his tests.

Dr. Max Einhorn, New York: (Closing the discussion). I would like to emphasize one point in connection with the tests, and that is, that nothing warm should be given to he patient for a time after the introduction of the capsules, because mutton fat will melt at a temperature of 50 C.

The man who discovered that there is a fat-splitting ferment in the stomach was Volhard, but the presence of such a ferment is of minor importance in connection with the test I have described. As a general rule, mutton fat is not changed in the stomach. These beads are surrounded with the fat and there is more or less mechanical friction against the walls of the stomach. If the test comes out in such a way that the beads, after having lodged in the stomach, are unchanged, while those lodged in the intestine have lost their fat, then the test is satisfactory.

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# AN EXPLANATION OF THE MOTOR ACTIVITIES OF THE ALIMENTARY CANAL IN TERMS OF THE MYENTERIC REFLEX.

WALTER B. CANNON
Boston.

A number of years ago, Nothnagel called attention to the fact that when crystals of sodium chroide were applied to the small intestine, their contact with the gut produced a contraction above and relaxation below. Similar observations were made by Mall later in experiments on dogs, and still later by Bayliss and Starling. These last experimenters declared that this was a local reaction in the wall of the gut, dependent on the nervous network there present in Auerbach's plexus.

About a year ago I adduced certain facts proving that the pylorus obeyed this same law. I showed that the presence of acid in the stomach stimulated the opening of the pylorus, while the presence of acid in the duodenum closed the pylorus and prevented the outflow of food from the stomach. Since that time I have made some observations, the details of which are still unpublished in regard to the control of the cardiac sphincter of the stomach, and these observations indicate that the cardiac sphincter likewise obeys this law. The experiments, briefly, were carried out as follows: the animal experimented on was given a certain amount of starch paste, with bismuth in suspension. Observation with the X-Ray then showed a rhythmic regurgitation of food into the esophagus; this continued for fifteen or twenty minutes, and then ceased. It occurred to me that possibly, just as the acid in the duodenum closes the pylorus, so acid in the stomach would cause the caradic end of the sphincter to be held



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closed so long as the acid reaction is present. A similar mixture of starch paste and bismuth was therefore rendered acid with hydrochloric acid and introduced into the stomach in the same manner as before. This time regurgitation into the esophagus did not take place. This observation has since been substantiated by other methods and on other animals, so that there is now evidence that the presence of acid in the stomach normally keeps the cardiac sphincter closed during digestion. The cardia therefore obeys the same law as the pylorus, namely, that stimulation below causes the contraction above. This led me to think that there was a unity in this respect throughout the entire intestinal tract, which view was strengthened by the knowledge we have of the similarity in the histological structure of the parts. There is perfect unity so far as the arrangement of smooth muscle fibres is concerned.

The observations made by Magnus several years ago rendered the determination of this problem relatively easy. He immersed a piece of small intestine in Ringer's solution, and through this solution he passed bubbles of oxygen, and in this way the movements of the intestine could be kept up for hours.

In my study I have used a slight modification of the methods of Magnus. Observations made on the lower esophagus showed that mechanical stimulation produced contraction above and relaxation below. This was not true of the upper part of the esophagus, which is under the control of fibres from the central nervous system. The cardiac and pyloric sphincters obey the same law as that prevailing in the intestine. The same degree of stimulation applied for the same length of time both above and below a given point showed that the stimulation below dominated over the stimulation above.

While this general law in the alimentary canal indicates that the canal is a unity, there is evi-



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dence at hand indicating a reversal of this reflex under certain abnormal conditions associated with states of increasing or high tonus. Where there is an increasing tonus of the musculature, a reversal of this law is to be expected. For example, in the large intestine the anti-peristalsis occurs immediately after the food enters the large intestine from the small. The entrance of food into the large intestine is followed by a strong tonic contraction, forcing the food into the transverse colon. There is then in the large intestine a condition which would lead to anti-peristalsis: a condition of high tonus which would result in a reversal of the peristaltic wave.

In the small intestine, the peristaltic wave does not repeat itself, because as the wave moves, it pushes the bolus which acts as its stimulus before it. It is a moving stimulant. In the stomach, however, the waves sweep down to the pylorus without pushing the food before them. The food remains stationary, and starts another wave. As a result there is repeated peristalsis.



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## DISCUSSION.

Dr. Max Einhorn, New York: A few years ago, when Dr. Cannon read his paper in New York, I mentioned achylia gastrica as an instance. In the same way, I found in one instance in my experiments that free hydrocloric acid was always present in the duodenum, no matter at what time the test was made. While these conditions are very rare, I believe that in certain diseased states, acid is always present in the duodenal contents.

Dr. J. C. Johnson, Atlanta: I believe that the findings of Dr. Cannon, along with the observations that he has made along these lines on previous occasions, have given us the basis for a better method of studying the relations between the chemistry of the stomach and the intestinal canal, and also for a clearer comprehension of their pathology. His work in experimental physiology is in close touch with the papers that we have listened to this morning. I have enjoyed the chain of connection between the three papers, and I think there is a promising outlook for the practical application of these physiological principles to the chemistry and pathology of the stomach and intestines, and that they will in the course of time lead to therapeutic suggestions, of especial value in the morbid reflexes to the musculature of the stomach.

Dr. J. A. Lichty, Pittsburgh: I have often seen the statement made that when particles of carbon or cork are introduced into the bowel, they are carried upward by a reversed movements of the bowel. I would like to ask Dr. Cannon whether in his experiments he has found a reason why such particles are carried higher than the point at which they were introduced.

Dr. Fenton B. Turk. Chicago: It is just such experiments as those described by Dr. Cannon that add dignity to internal medicine, and I would not like to spoil the effect of what we have heard by injecting into it any discussion of a clinical character. The interesting and valuable data of the essayist is purely scientific. His observations confirm and elucidate those of Starling, and he has told us exactly what takes place both above and below the point of the stimulus. I believe Dr. Cannon was the first to observe that the presence of hydrocloric acid in the stomach caused the pyloric orifice to open, and now he has shown us that this same agent causes the closure of the cardiac orifice.

In my own experiments along these lines, I could not obtain the degree of peristalsis necessary from the application of various chemical agents to the mucosa of the stomach. The use of hydrochloric acid, in physiological doses, was applied to the mucosa or sprayed upon it, and various articles of food in different states of digestion

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were also tried, but these did not invoke peristalsis in the resting stomach, but upon tension (stretching the stomach with air) or pinching, which means tension, I found that immediate contractions were produced, and that by gradually relaxing and increasing the tension, the peristaltic movements were much increased, and antiperistaltic waves were eventually found to occur as the point of maximum stimulation was approached. Dr Cannon's observations were much more accurate than those that I was enabled to make. His paper marks a great advance in our knowledge of the physiology of the gastric and intestinal movements.

Dr. Walter B. Cannon, Boston: (Closing the discussion). In reply to the question asked by one of the speakers, I may say that Meisner's plexus has nothing to do with the production of this local reflex. In the observations I made, both plexuses were present, but the reflex was due solely to that of Auerbach. There was no evidence that Meisner's plexus was essential to the reaction that was observed, and I am unable to say what the function of Meisner's plexus is.

In reply to Dr. Lichty's question as to whether particles of carbon or cork injected in the bowel *per rectum* were carried further up by anti-peristaltic action, I may say that some years ago some experiments were made which indicated that after relatively large injections, sufficiently high to carry the material to the region of the ileo-colic sphincter, where the anti-peristaltic waves were set going, the injected material might be carried back throughtout almost the entire length of the small intestine, and then the mechanical processes of that section of the gut would take place: these movements were the same, no matter from which end the food entered. These experiments were reported in the American Journal of Physiology, in January, 1902.

I cannot explain Dr. Einhorn's case of achylia gastrica, in which the findings seem to negative all the physiological evidence that has been gathered during the past four or five years. In that case there must have been some unexplained compensatory mechanism; otherwise, I cannot account for the flow of bile and pancreatic juice, which depends on the presence of acid in the duodenum. The case is a mystery to me at present. In the case in question, it would be interesting to know in what portion of the duodenum the bucket was, and whether or not it was possibly at least partly filled with acid contents before or after it entered the duodenum. Careful experimenal observations have shown that even under normal conditions the contents of the duodenum are acid in reaction for the first few inches of the small intestine, but that below that point the reaction is neutral.

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Dr. Turck asked me, so I understand, if I was not the first one to make the observation that the closure of the pyloric orifice was due to the presence of acid in the duodenum. This discovery cannot be ascribed entirely to me. Hirch, about fifteen years ago, observed that when acid was introduced into the duodenum, there was a cessation of discharge from the stomach. No proof was given, however, that effect was on the pylorus. Indeed the result has been attributed to the effect of the acid on the peristaltic movements of the stomach. It was not until the X-Ray was introduced that we could differentiate between these two factors of gastric discharge.

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# PLASTIC PERITONITIS.

G. W. McCaskey
Fort Wayne, Ind.

My principal object this afternoon is to present to you some very unique specimens. The case which they ilustrate will be reported in full by my colleague, Dr. Miles F. Porter, of Ft. Wayne, before the Surgical Section of the American Medical Association during the present week. These specimens which I herewith present have been examined pathologically by Dr. William H. Welch, of the Johns Hopkins University; he stated that he had never seen anything like them, and considered the case absolutely unique in medical literature.

The patient was a man about 35 years old who consulted me a year ago on account of persistent vomiting, abdominal pain, and general debility. The pain was in the lower half of the abdomen, and principally in the right lower quadrant. A diagnosis of appendicitis had been made by a physician in his home town. The vomiting of which he complained was irregular in character; it sometimes occurred after eating, and sometimes without reference to meals, and it had been going on for some months. The vomitus was always of a greenish color. This did not resemble bile, but had the appearance of the pigment produced by the bacillus pyocyaneus. The man's temperature remained practically normal, even perhaps subnormal until just before his death. The pulse was also substantially normal. These were the general features of the case. I saw him two or three times, and finally advised him to enter the hospital. An analysis of the stomach contents showed a normal amount of hydrochloric acid—



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about 30 or 40 degrees. I examined the greenish pigment in the vomitus, and found what I thought to be the bacillus pyocyaneus. I turned it over to Dr. B. W. Rhamy, of Ft. Wayne, and the only conclusion he could reach was that it was Eberth's bacillus I corresponded with the members of the patient's family and was informed that he had never had any continued fever of any sort in his life. The examination of his urine was entirely negative. After thorough lavage of the stomach, the greenish pigment would be found there again in full quantities within two of three hours, indicating undoubted reguritation from the intestinal canal. The previous history he gave was negative, with the exception that about fifteen years before he had suffered from empyema, which necessitated the resection of one rib, and which was suggestive of tubercular trouble. He gave a history of a three distinct attacks of intense paroxysms of pain in the lower right quadrant of the abdomen; these attacks lasted for several hours, and required the use of morphine. I gave him charcoal, which reappeared in the stools, showing that the intestinal canal was permeable throughout. I also gave him injections of tuberculin, with negative results. He was also given a number of injections of an auto-vaccine made from the organism found in the vomitus, this raised his opsonic index from about 43 to 100, but did not benefit him any.

Finally, an exploratory incision was advised, and the patient was turned over to Dr. Porter, with the provisional diagnosis of plastic peritonitis, although no one had any conception at the time of the real pathological condition, as found at autopsy.

The operation showed that the intestines were matted together in a peculiar way. It was impossible to unfold them, and as nothing further could be done, the abdomen was closed. The case ended fatally, and the autopsy showed that a slowly



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progressive peritonitis, probably of long standing, had firmly matted the intestines together. The plastic exudate forming on the peritoneal surfaces had gradually contracted the intestines, longitudinally infolding them close together, and thus obliterating at least three-quarters of the intestine. These measurements were subsequently corroborated by Dr. Welch. A cross section of the intestine, after removal of the plastic exudate, showed that the lumen of the gut was apparently practically obliterated; it was apparently absolutely blocked, yet the charcoal test had shown that it was permeable. After releasing the intestine from its plastic exudate, it could be stretched to its normal length and was found to be in almost perfect condition. In examining some of the sections, Dr. Welch found some microscopic changes, but none of a gross character of the wall of the gut. He was undecided about the pathology of the case. Personally, I am inclined to believe that the organism which I found, and which Dr. Rhamy regarded as the Eberth bacillus, produced this plastic exudate. Dr. Welch seems inclined to think it was tubercular. At the autopsy, partial consolidation of the upper lobe of one lung was found. The lung on that side had evidently collapsed at the time of the patient's attack of empyema fifteen years ago, and had never fully expanded afterwards. No fluid was found in the abdominal cavity; the gall bladder was normal.



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Reprinted from the MEDICAL RECORD, November 28, 1908.

# CHOLECYSTITIS, WITH SUGGESTIONS FOR THE PREVENTION OF GALL-STONES.*

BY HENRY WALD BETTMANN, M.D.,

CINCINNATI, O.

CHOLECYSTITIS is an inflammation of the gall-bladder due to infection. By far the most frequent cause is the colon bacillus; the typhoid bacillus is responsible for many cases; occasionally cholecystitis is caused by the pus-formers, the influenza bacillus, or the pneumococcus. Tuberculous cholecystitis is very rare. The manner of infection is not always clear. It is highly probable that in nearly all cases, the infecting bacteria reach the gall-bladder by way of the portal circulation. Ascent from the duodenum through the papilla of Vater is uncommon. Infection through the arterial circulation is also unusual. Just what conditions permit of an invasion of bacteria through the portal circulation is not always clear. The most frequent result of cholecystitis is the formation of gallstones. It may be considered as proved, that gallstones occur only as a sequel of catarrhal cholecystitis or cholangitis. The clinical history of gallstones has been pretty well worked out. We know the cause, the symptoms, the complications, and the cure. The

*Paper read at the eleventh annual meeting of the American Gastroenterological Association at Chicago, June 1, 1908.

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underlying disease, viz., the cholecystitis, has not received nearly the attention it deserves. Cholecystitis is probably the most frequent inflammatory disease within the abdomen. Nevertheless it is scarcely recognized by the profession as a disease *per se*. The fact that it is so frequently complicated by gallstones, has focused the attention on the latter disease and has strangely retarded our recognition of the significance of cholecystitis as the primary and often the more important condition. The history of appendicitis is closely analogous. The most serious complication of appendicitis, viz., peritonitis, caused the nature of the underlying disease to be entirely overlooked up to within very recent times. Chiefly through the influence of the surgeons, the profession at large were taught to recognize appendicitis when they saw it, and it is only since the general practitioner has learned to diagnosticate the milder forms of appendicitis, that the enormous frequency of this disease has been generally recognized. Now exactly the same history will repeat itself in regard to the inflammations of the gall-bladder. Almost all the cases of mild cholecystitis have hitherto been entirely overlooked or wrongly designated. Countless cases are set down as attacks of gastritis, spoiled stomach, acute indigestion, or even appendicitis. As a result, we are not yet in a position to state just how frequent cholecystitis actually is, or under what conditions it may occur; we cannot say in what proportion of cases one attack is followed by others; we do not know in what proportion of cases gallstones are formed; we cannot say surely whether we can influence the formation of stones or not. In fact, the whole clinical history of cholecystitis remains to be written.

The object of the present paper is to throw a little



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light on a few of the more important clinical features of the disease. During the past 18 months I have had the opportunity of observing nearly 120 cases of gall-bladder disease. My conclusions are based largely on a study of these cases. In many of them, complete data were not obtainable.

*The relation of cholecystitis to child-bearing.*—A large number of observations has led me to believe that, in women, pregnancy and especially the puerperium directly lay the foundation for the primary infection of the gall-bladder. Furthermore, it seems exceedingly probable to me, from personal observations and a close study of the clinical histories, that in women the great majority of gallstones have their inception in attacks of cholecystitis during the active child-bearing period. These conclusions are based on the three following observations:—

(1) I have personally observed in many cases acute primary attacks of cholecystitis within a few weeks or months of parturition.

(2) I have repeatedly seen acute exacerbations of cholecystitis in the puerperium.

(3) Many women who are subject to gallstone attacks give an unmistakable history of cholecystitis immediately following some preceding confinement.

It is not hard to see why the puerperal state should predispose to infections of the biletract. It is generally said that pregnancy lends itself admirably to stagnation of the bile. Personally, I believe that the phrase "stagnation of bile" lacks scientific definiteness and has more theoretic than actual existence. Clinically, we know nothing of stagnation of bile, except that due directly to obstruction. During the puerperium, however, the pelvic lymphatics and veins are overloaded with waste products from the placental site and the involuting uterus.



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Even at its best, the liver is not always able to bar the progress of bacteria from the incoming portal blood into the bile. In the puerperium we have a frequent combination of constipation, overeating (often indulged in for the sake of the milk supply), physical inactivity, and a portal blood supercharged with waste material. What better opportunity could be offered the ever-ready *B. coli* for a successful invasion of the biletract?

*Primary attacks of cholecystitis occur usually between the ages of 20 and 35.* After the frequency of catarrhal cholecystitis becomes generally recognized by the profession, it will require some years of observation to determine definitely at what age cholecystitis is most prevalent. Autopsy findings indicate that gallstones are more common after 30 than before, and still more common after 40. My own observation leads me to believe that cholecystitis is comparatively rare before the age of 20, that it occurs with very great frequency between 20 and 30, especially in women, and that the majority of primary attacks occur before 35. Attacks of cholecystitis which take place after the age of 40 are usually recurrent ones, and in the majority of instances are already complicated by the presence of stones. If these observations and conclusions are correct, it would seem that cholecystitis in a very large proportion of cases precedes the formation of stones by months or years, and that patients frequently have recurring attacks of cholecystitis long before stones are formed. It is established by operations, that a certain proportion of sufferers from cholecystitis escape cholelithiasis altogether; but it is not possible in the present state of our knowledge to say just how large this proportion is.

*The interval between the primary cholecystitis*



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*and the formation of gallstones is universally neglected by physicians.* Kramer (*Journal of Experimental Medicine,* May, 1907) has shown that when colon bacilli are grown in a sterilized mixture of alkaline peptone bouillon and bile, a gradual precipitation of cholesterin and other components of gallstones occurs. At the end of four weeks a closely packed semisolid mass can be seen at the bottom of the tube. After six months, the supernatant fluid can be poured off, leaving a well molded mass resembling soft gallstones.

Ten years ago, Mignot showed that gallstones can be produced experimentally in dogs, in 4 or 5 months. Numerous cases are reported, making it seem very probable that human gallstones can be formed in from 4 to 8 months. So far as we know, the formation period may often be very much longer. Whether bacteria must continue to grow in the gall-bladder during this whole period, in order that stones should be formed, is not as yet definitely known.

Kramer has suggested that the precipitation may be due to the acid reaction of the bile induced by the growth of the *B. coli* or *B. typhosus.* Now it seems probable that the interval between the primary cholecystitis and the deposit of cholesterin would be a most fruitful one for therapeutic endeavor. It may be regarded as conclusively demonstrated that the usual treatment of the gall-bladder is effective in reducing inflammatory conditions and in a measure preventing their recurrence. No observer can doubt that the usual Carlsbad treatment or the Carlsbad method modified for home use, has a certain utility in well-established cases of gallstones. Now that the exciting cause of gallstones can be recognized clinically, months before their actual forma-



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tion, it seems to me we permit the golden opportunity to escape, when we do nothing for our patients during the months following an acute attack of cholecystitis. During the attack, the patient should rest in bed and should have warm Priessnitz compresses over the upper half of the abdomen. Opiates should be given to relieve pain if necessary. The diet should be exceedingly limited during the first few days, and all cathartic drugs are contraindicated. After the swelling of the gall-bladder has subsided and the local soreness has disappeared, the patient may be out of bed most of the day. The diet should consist largely of cereals, meat, simple vegetables, bread and butter. Alcoholic drinks, acid foods, and fruits should be prohibited. The use of salines should be begun early.

Sulphate of sodium, phosphate of sodium, bicarbonate of sodium, and salicylate of sodium may be given in various mixtures. They are best administered dissolved in plenty of hot water, one-half to one hour before each meal. I do not believe there is any special virtue in the salicylate of sodium, not possessed by the other drugs mentioned; nor do I think it advisable for the patient to eat more than the three regular meals a day. It is possible that urotropin or other drugs may prove to have unusual value. Under this simple treatment, continued for months, or if need be for years, patients are given an excellent chance to escape recurrence of inflammation, and in fact all symptoms referable to the gall-bladder.

I cannot state with certainty that the formation of stones is thereby actually prevented. Proof of such an assertion would be exceedingly difficult to offer. If we get rid of the inflammation, the gall-bladder may of itself dispose of the salts already



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precipitated within it. This was experimentally demonstrated by Bain, in 1905, who showed that if gallstones are introduced into the healthy gall-bladder of dogs, they are dissolved in the course of a few months.

I do not believe that well-formed gallstones are ever dissolved within the human gall-bladder. Nevertheless, most of the symptoms of cholelithiasis are due not to the stones themselves, but to the associated cholecystitis. After the stones are formed, the tendency to recurrent attacks of cholecystitis is increased. Symptoms which do not promptly disappear under appropriate medical treatment or which recur notwithstanding proper habits of life, call for surgical intervention.

LEVERONE BUILDING.



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## DISCUSSION.

DR. G. FÜTTERER, CHICAGO: In a general way I wish to say that it is true that the bacterial infection of the gall bladder has not yet received the necessary attention. It is also true that many do give it this attention, and I hope this activity will spread; in fact, it is necessary that it should spread.

In 1888 I recovered pure cultures of typhoid bacilli from the gall bladder of patients who had died of typhoid fever. At that time, nobody believed that my findings were correct, because they thought the bacilli could not live in the bile, which was supposed to be antiseptic. I will say right here that at last this matter has been settled in favor of the opinion expressed at that time, although it took about twenty years to do it.

In connection with my investigations of infection of the gall bladder with typhoid bacilli, the first question which presented itself to me was, how do they get there? Do they come from the intestine or general circulation? I did not think it probable that they came from the intestine, (1) for mechanical reasons; (2) because they were always found in pure culture. It did not seem probable to me that they alone of all the intestinal bacteria, should enter the gall bladder, and it seemed to me more likely that they found their way there through the general circulation. To verify this theory I injected the bacilli prodigiosus into the left cavity of the heart, and was able to obtain a culture from the gall bladder within two hours. I also injected them into the portal vein, and with the assistance of Dr. Emil Ries, was able to obtain a culture from the jugular vein in a fraction of a minute. In these experiments, Dr. Ries worked independently, using his own instruments, so that the possibility of contamination could be ruled out. I also injected some into the common duct after ligation of the duct, and when they had passed into the general circulation in this way I was able to obtain a culture by introducing a tube into the common duct below the point of ligation.

To be sure, in the course of time these findings have been proven to be correct, and typhoid fever is no longer looked upon as an intestinal disease, but as a general infection.

Another thought that suggested itself to me was that the relapses of typhoid must come from the secondary infection of the gall bladder. Welch and many others have shown that the typhoid bacilli may remain in the gall bladder for ten years or even longer, and it has also been shown that there are individuals who have a typhoid infection without the intestinal symptoms. That would explain the relapses that may come on any time, as late as ten weeks or months or years after the original attack. In Germany they call people who have had typhoid and typhodidal infection of the gall bladder *Bacillenträger,* and

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they are regarded as a source of public danger, because at any time they may infect the soil. The question now arises, can we do anything to destroy or mitigate the effects of the typhoid bacilli within the gall bladder? Ten years ago I injected typhoid bacilli into the gall bladder of animals, and then gave them various kinds of medical treatment without any effect whatever on the bacilli. Probably the most logical preparations would be the salicylates. Stadelmann of Berlin, who has studied cholagogues all his lifetime, has come to the conclusion that ox-gall and the salicylates are the best cholagogues, and as salicylate is at the same time a disinfectant, the combination seems to be a very good one. Still, I have not been able to see any benefit from it.

The acute symptoms of cholecystitis I have found yield very quickly to oleum gaultheria which I prefer to the salicylate of sodium. The gall bladder may not empty itself for long periods of time, because its walls have become rigid. I know of only one remedy to resort to in dealing with typhoidal infection of the gall bladder, and that is to open the gall bladder, wash it out and drain it.

Dr. John A. Lighty, Pittsburgh: I was very much interested in Dr. Bettmann's paper, the object of which, as I understand, is to show that in cholecystitis there is a pre-gallstone time which should be recognized by internists, and treated with the object, if possible, of preventing the formation of gallstones. I think that is a very interesting and important point of view, but I do not quite get the idea from the author as to how he is able to recognize this pre-gallstone period. How he will be able to say that this case is or is not one of pure cholecystitis, without the presence of gallstones?

During the past year I have seen two cases of typhoid fever in young persons who, during the stage of convalescence, after the temperature had been normal, developed attacks of pain in the upper abdomen, with tenderness over the gall-bladder region, with rigidity of the right rectus and leucocytosis, and had all the usual symptoms of cholecystitis, and yet I do not see how I could say definitely that they were examples of cholecystitis without the presence of gall-stones. These patients had been entirely healthy up to the time of their attack of typhoid fever.

The only case I have seen in which I was sure of the diagnosis of cholecystitis without stone was in an elderly man in the wards of the hospital who had had typhoid fever and still had a slight hectic temperature, and who when he moved about in bed had a little pain in the region of the gall bladder. A surgeon was asked to see him, and it was decided to drain the gall bladder. This was done, disclosing a cholecystitis; the gall bladder contained typhoid bacilli, but no stone.

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Dr. Jesse S. Myer, St. Louis: For some time I have been greatly interested in the subject of cholecystitis, especially with reference to its part in the formation of gall stones. I feel that Dr. Bettmann has under-estimated, perhaps, the importance of stagnation, not only in the development of the chronic cholecystitis, but also in the formation of gall stones. So far as I know, there is not a hollow viscus in which stagnation is not possible, and I see no reason why it should be doubted in connection with gall bladder. About eighty or ninety per cent. of the gall stone cases we see are in women, and a large proportion of those met with in the male sex are in old men. There must be some definite reason for this, and the most probable one is that it is due to the stagnation of bile in the gall bladder as the result of abdominal relaxation and a disturbance in the intra-abdominal pressure. It has been pretty thoroughly shown that infection of the mucous membrane of the gall bladder is not, in itself, sufficient to result in the formation of gall stones so long as the bile can readily be expelled into the duodenum. The expulsion of bile into the duodenum depends on several factors. It depends on the normal state of the cystic and common ducts; on the pressure exerted by each respiratory act upon the gall bladder and on the normal state of the musculature of the gall bladder itself. All of these factors may be disturbed in relaxed conditions of the abdominal wall. About eight or ten years ago I studied the subject from this standpoint; and at that time became well acquainted with the work of Dr. Fütterer. I feel convinced that pregnancy is not only a factor in the causation of cholecystitis, but especially in the prolongation of cholecystitis.

Dr. Franklyn W. White, Boston: The paper of Dr. Bettmann is especially valuable, as it emphasizes the fact that prevention is likely to be the only satisfactory medical treatment of gallstones. Naunyn of Strasburg has found no evidence of the dissolving of gallstones by medical treatment except in two or three instances out of one thousand. To prevent their formation, therefore, is the most hopeful treatment. The great difficulty lies in making a sufficiently early diagnosis. In the vast majority of cases, gallstones probably remain latent for long periods of time.

I would ask Dr. Bettmann why he believes that the original attacks of cholecystitis usually occur before the age of 30?

Dr. J. C. Johnson, Atlanta: In the production of gallstones, I think emphasis should be laid on the stagnation of bile. I have noticed in some cases that there has been an absolute lack of secretion in the stomach, alternating with marked hyperchlorhydria.

As regards treatment, I believe that such remedies as phosphate of soda, oleate of soda and olive oil owe their value to their laxative effect on the duodenum, thus increasing the patency of the ducts. Anything which favors

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muscular relaxation of the parts, will favor the passage of the stones. The more normal the condition of the duodenum, the less trouble will there be in the gall bladder, irrespective of the presence of stone or any mechanical disturbance there. I have watched this very closely, and I have found that where there have been recurrent attacks, that alkalies given before meals lessened the amount of hydrochloric acid, and warded off the attacks for some time. The best results I have obtained were from the oleate of soda; I have also used phosphate of soda, and more recently I have added the extract of belladonna. Laterly, I have also used urotropin. I do not know that I can fully explain just why, but in my hands this combination has been beneficial in treating these cases. I think it is reasonable to suppose that a faulty metabolism has much to do not only with the formation of gallstones, but with the actual condition of he gall bladder itself. When we consider the composition of bile, the source of its formation, and its relation as an excretory product to the rest of the body, I think we can see that such a combination as I have mentioned may have some effect in inhibiting the trouble, and generally being beneficial. I am convinced that I have gotten good results from it as a preventive measure.

Dr. Henry Wald Bettmann, Cincinnati: (Closing the discussion.) I regret that my paper was so long that I did not take the time to read it *in toto*. I did so with the idea of sparing you the experimental data, which really formed the foundation of the clincal facts presented by the paper. Those who have followed the experimental and pathological work of the past ten years, which was summarized by Herter before the American Association of Physicians in 1900 in Washington, no longer have any doubt that cholecystitis is always due to an infection, that gallstones only form in an infected gall bladder, and that the causative factor in the majority of instances is the colon bacillus and in the minority of cases the typhoid bacillus. The more virulent forms of infection do not lead to the formation of gallstones, because they destroy the mucous membrane of the gall bladder, and the cholesterin salts which constitute the stones are prevented from being formed. In 10% of all post-mortem examinations gallstones are found, and if they are due to an infection of the gall bladder and cholecystitis, it is natural to ask, when did those individuals have the infection and the pre-existing cholecystitis? If from seven to ten per cent. of all persons living to old age have gallstones and have had a preceding infection of the gall bladder, is it not possible that we have overlooked the preceding infection, or have called it by another name, or, as suggested by Dr. White, is it possible that this infection can run an entirely latent course? I have been led to believe that the infection of the gall bladder is never a latent disease, and can always be recognized by well-defined physical signs. I have recently summarized my views in two articles on this subject, which were published in The

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Archives of Diagnosis, Nos. 1 and 2. The condition, I believe, is too often mistaken for what we term "spoiled stomach," "acute intestinal catarrh," "appendicitis," and so on, and if in those cases we examine the gall bladder region, we will be surprised in how many instances we can actually demonstrate the presence of an enlarged, inflamed and therefore very tender gall bladder. This method of physical examination has not been as universally adopted as it should be: with one hand on the anterior abdominal wall and the other in the loin, the patient is instructed to take a deep inspiration. Pressure is then made just within the attachment of the 9th rib, and upon expiration the patient winces as we compress the gall bladder region.

The mere frequency of acute cholecystitis is proof of the fact that we have overlooked it, and my investigations on the subject have led me to believe that it is never latent, and that we can recognize it if we but hunt for it. Twenty years ago, nobody knew of the existence of appendicitis in its milder forms, and it was not until the surgeon found that peritonitis was due to appendicitis, that we learned to look for and recognize the physical signs of the lighter degrees of that affection. Now, even a practitioner of ordinary experience can recognize mild appendicitis by the rigidity of the rectus and the other symptoms, and I am convinced that the same evolution will take place in regard to cholecystitis.

One of the speakers said that from 80 to 90 per cent. of gallstones occurred in women. The proportion, as ordinarily given, is less than that. Cholecystitis is probably four or five times as frequent in women than in men, and about 90% of the female cases are in married women.

If gallstones are due to cholecystitis, and we are able to recognize cholecystitis, are we not neglecting our patients when we do nothing for them? We know that cholecystitis precedes the formation of gallstones. I believe we are able to recognize it. Then is the time to interfere and by keeping up the flow of bile, and resorting to the medical expedients which we know are successful in reducing inflamaory conditions we will probably often prevent the formation of stones. We know that a meat diet causes a freer and more continuous flow of bile; therefore, these patients should be placed on a meat diet. Saline waters should be given before meals. Instead of waiting until the presence of gallstones can actually be demonstrated, these and other measures should be undertaken upon the first demonstration of cholecystitis.

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# A FURTHER STUDY OF THE INFLUENCE OF EXTIRPATION OF THE SALIVARY GLANDS ON THE GASTRIC SECRETION.

J. C. HEMMETER
Baltimore, Md.

The mechanism of gastric secretion reveals itself as a complex one. Pawlow following the work of Bidder and Schmidt has definitely established on a solid experimental basis the existence of a psychic secretion, pure and simple, brought about solely through nervous paths. Edkins l. c. has demonstrated the existence of a pyloric SECRETION or HORMONE.

Tarulli and Pascucci in Luigi Luciani's Laboratory (PHYSIOLOGIE DES MENSCHEN LUCIANI, Bd. 2, p. 151), have conducted experiments demonstrating the existence of peptogonous substances that can be extracted from the spleen during the height of digestion.

The present series of experiments strongly suggest that the existence of a hormone capable of stimulating gastric secretion occurring in the salivary glands and acting by way of the blood stream. At the beginning of this series of experiments it was found that occasionally in animals that had been provided with accessory stomachs, and from whom the salivary glands had been removed, would show absolutely no gastric secretion whatever; and upon this phenomenon erroneous conclusions were based, which were stated in a preliminary communication which was published in SCIENCE, October 11, 1907, p. 473, New York. It was there stated that in dogs with accessory stomachs removal of the salivary glands abolishes permanently all gastric secretion. This was observed to be true in three dogs operated



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in the manner described, but in two of these animals that were kept for six months after the operation a gradual and partial resumption of the gastric secretion was observed. The complete loss of the gastric secretion first observed after any severe operation upon the animal is due to the direct insults to the secretory apparatus caused by the operation itself, to traction upon the nerves, or due to reflex nerve influences, for Pawlow states (Work of the Digestive Glands) that a stimulation of the sciatic nerve a very few minutes may cause an arrest of gastric secretion for many hours, l. c., p. 69. It is, therefore, necessary in these experiments to observe the animals a long time to allow for complete recovery, before the chemical studies of the gastric juice are undertaken. Contrary to the dog's whose gastric secretion is immediately abolished after an operation, we have occasionally come across an animal in which the gastric juice continued to be secreted after extirpation of the salivary glands. Whilst it was not secreted in the normal amounts, yet the diminiution was not what was discovered to be the case on an average in the other animals given in the tables. We believe this continuation of gastric secretion to be due to an abnormal condition of the glandular apparatus of the stomach of the dogs before the operations are undertaken. The pathologic condition of secretion which is very perplexing in this connection is hyperacidity, and hypersecretion. Pawlow has already described a dog with hyperacidity, and M. Pewsner (BIOCHEMISCHE ZEITSCHRIFT, Bd. 2, p. 344) gives a description of a dog suffering from hypersecretion. The most confusing abnormality, however, is a condition first described by myself, and termed "HETEROCHYLIA." This is an alternating state of gastric secretion which expresses itself by marked excess of all constituents of the juice at one time, and complete cessation of the secretion at another time after the identical test



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meals. That this condition exists has been confirmed in the laboratory of Professor I. Boas, of Berlin (see ARCHIV fur VERDAUUNGSKRANKHEITEN, Bd. 8, s. 75). All such abnormalities of secretion render the animal unfit for this kind of experimentation.

It has been our experience that any long continuance of a normal gastric secretion after the removal of the salivary glands was due to either one of the following three factors: (a) that the lobules of the parotid glands had not been completely removed. This is surgically the most difficult gland to extirpate completely, (b) that the psychic secretion has not been thoroughly eliminated, which if at all started up, will convert the food into peptogenous substances capable of stimulating the formation of the pyloric hormone or secretion, first described by Edkins, (c) that abnormalities of secretion existed similar to those described in the preceding.

## SYNOPSIS AND PRINCIPAL CONCLUSIONS.

1. In dogs with simple gastric fistula the extirpation of all of the salivary glands produces a marked diminution in the gastric secretion. This is also evident in the analysis of test meals drawn by the test tube from animals with intact stomachs. It is necessary to prevent psychic secretion in order to bring about the phenomenon described.

2. Even in animals with intact vagi it may sometimes happen that the removal of all the salivary glands causes a decided impairment of gastric secretion. So that a causative relation between the loss of the salivary glands and the reduced proteolytic and milk coagulating power of the gastric juice appears certain, even in these cases.

3. In nine salivary dogs in whom the gastric secretion has been decidedly diminished, it is not restored to the normal by the feeding of food



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that has been well masticated and insalivated by other normal dogs.

4. When the gastric secretion is diminished, a temporary restoration may be brought about by intravenous or peritoneal injection of extracts made from the salivary glands of normal dogs.

5. This temporary restoration of gastric secretion takes place even when the stomach is isolated from the central nervous system.

6. The chemical co-ordination of the gastric secretion is effected by hormones that have different origins; some are contained in the food itself (Schiff, Bayliss and Starling), others originate in the pylorus mucosa, still others originate in the spleen (Luciani), and the present series of experiments indicate the existence of a HORMONE stimulating gastric secretion which is formed in the salivary glands. Salivary gland extract fed directly with the food or placed into the stomach directly is not capable of exciting gastric secretion. Ground up fresh salivary glands cause approximately the same gastric secretion as an equivalent amount of ground beef in these animals.

It is possible that these different chemical mechanisms exert different effects on the gastric secretion.

It will be our duty in a further communication to point out that the purely nervous or psychic secretion, and the gastric secretion which is kept up by chemical stimulation or hormones, although in the normal animal they act synergistically, have different objects; the psychic secretion effecting the primary phase of secretion, i. e., the discharge of prozymogen granules and acid already in the secreting cells, and the chemical mechanisms controlling the secondary phase or the reconstruction of cytoplasm.

The previous experiments at extirpation of salivary glands, too much significance was attached to the fact that animals may live and



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digest fairly well without salivary glands. To this objection we may reply that animals may live and digest fairly well without spleens, or even after the entire stomach has been excised. As has been stated in the preceding, the co-operation of the salivary glands in the formation of pepsin and hydrochloric acid does not exclude the possibility that pepsin and hydrochloric acid can be formed in the absence of salivary glands. It has been demonstrated, for instance, that the spleen plays an important part in the formation of trypsin from its corresponding zymogen, Luciani, L. C. p. 78. This was already suggested by M. Schiff in 1862, viz., that the congested spleen at the height of digestion gives off a substance into the blood which is utilized by the pancreas for the formation of trypsin, and although his results were received with scepticism, they were later confirmed by Herzen, Gaschet and Pachon. Later on, F. Bellamy, Mendel and Rettger reached conclusions confirming the doctrine of Schiff, so that it is now accepted that the spleen is actively concerned in the formation of trypsin; but nevertheless it has been found that the pancreas of animals that have undergone complete excision of the spleen may contain trypsin. This controversy on the relation of the spleen to the formation of trypsin is instructive as throwing light on the relation of the salivary glands to the stomach. The fact that pepsin and HCl can be formed in the absence of the salivary glands cannot be taken as proof that the salivary glands do not form a peptogenous substance. The experiments described in the preceding lend sufficient proof to the doctrine that the salivary glands do exert an influence on the formation of gastric secretion.



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Neue Folge. Sonderabdruck 1908. Nr. 17.

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Zentralblatt für die gesamte Physiologie und Pathologie des Stoffwechsels.

Herausgegeben von
Karl von Noorden, Wien.
Alfred Schittenhelm, Erlangen. Ernst Schreiber, Magdeburg.

Verlag von
Urban & Schwarzenberg,
Berlin N. 24, Friedrichstr. 105 B. Wien I, Maximilianstr. 4

Wörtlicher Abdruck von Artikeln dieses Blattes verboten.
Referate mit Quellenangabe gestattet.

(Aus dem Sheffield Laboratorium für Physiologische Chemie der Yale-Universität. New-Haven Connecticut U. S. A.)

# Das Verhalten einiger unverdaulicher Kohlehydrate im Verdauungstrakt.[1])

Von
**Lafayette B. Mendel.**

Unter normalen Diätsbedingungen werden die Kohlehydrate unserer Nahrungsmittel sehr gut ausgenutzt. Reduzierender Zucker findet sich nicht in den Exkrementen, unveränderte Stärke ist selten, wenn der Verdauungsvorgang ein befriedigender war, und nur ein kleiner Rest Zellulose bleibt zurück, als nutzloser Teil jener Gruppe von Nahrungsmitteln, welche gewöhnlich am meisten gegessen werden. Der experimentelle Nachweis dieses Zustandes, besonders mit Bezug auf den in den zivilisierten Ländern gefundenen individuellen Durchschnitt ergibt sich aus zahlreichen wie folgt zusammengesetzten Daten.[2])

Ausnutzungs-Koeffizienten verschiedener Nahrungsmittelgruppen und der Gesamtnährstoffe bei gemischter Diät.

| | Protein | Fett | Kohlehydrate |
|---|---|---|---|
| Animale Nahrung | 97 % | 95 % | 98 % |
| Cerealien | 85 | 90 | 98 |
| getrocknete Gemüse | 78 | 90 | 97 |
| Zucker und Stärke | — | — | 98 |
| Vegetabilien | 83 | 90 | 95 |
| Obst | 85 | 90 | 90 |
| Pflanzennahrung | 84 | 90 | 97 |
| Gesamtnahrung | 92 | 95 | 97 |

Um diese ausgezeichnete Ausnutzung der Kohlehydrate richtig zu schätzen, muß man sich erinnern, daß diejenigen, welche unsere gewöhnliche Kost bilden, im Charakter einander gleichen, in chemischer Struktur nur geringe Verschiedenheit aufweisen. Der Ernährungstrakt der Mammalier ist gut eingerichtet, um Glykogen, Stärke, Rohrzucker, Maltose und Laktose zu verdauen und sie zum Zwecke der Absorbierung in die geeignete Form des $C_6$ Zuckers vorzubereiten.

[1]) Vortrag vor der »American Gastro-enterological Society«. Versammlung in Chicago, 2. Juni 1908.

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Nur Zellulose widersteht in höherem Grade der Verdauungskraft der Ernährungssäfte. Schon oft suchte man die Möglichkeit, solche Nahrungssubstanzen zu verwenden, welche Kohlehydrate bilden, die in unserer eben gegebenen Liste nicht angeführt sind. Die Liste solcher Nahrungsmittel ist im Laufe der Jahre durch wissenschaftliche, sowie kommerzielle Bestrebungen beträchtlich vergrößert worden. Pentosane, Galaktosane, Lävulosane, Pektinsubstanzen, Gummiarten und ihre Derivate, die verschiedensten Polysaccharide, welche in großer Menge in Pflanzen enthalten sind, wurden als geeignete künstliche Nahrungsmittel unter verschiedenen Einflüssen der Wahl oder Notwendigkeit ausposaunt. Es gab eine Zeit, die gar nicht so fern liegt, wo eine einfache chemische Analyse, die das Vorhandensein von Protein, Fett oder Kohlehydraten bestätigte, genügend war, diese Dinge enthaltende Substanzen in die Liste der Nahrungsmittel einzureihen. Die Erkenntnis, die Notwendigkeit der Verdauung höher zu würdigen als die Verwertung, und das Verständnis für die Funktion der hydrolytischen Spaltung der Polysaccharide mit Bezug auf ihre Beteiligung im Stoffwechsel muß der rückhaltlosen Aufnahme, welche Kohlehydrate enthalten könnten, in die Liste der Nahrungsmittel ein gebieterisches Halt zurufen. Die verdauenden Enzyme der Nahrungsmittel sind in ihrer Tätigkeit spezifisch, z. B. Extrakte von Vogeleingeweiden können wohl Rohrzucker, aber nicht Laktose invertieren, während die Eingeweide erwachsener Säugetiere ein Enzym bilden, durch welches diese beiden Disaccharide in $C_6$ Zucker verwandelt werden können.[1]) Einige der niederen Tierformen sind sogar imstande, mit Hilfe ihrer Cytase aller derjenigen Stoffe Zellulose zu verdauen. Es scheint daher geboten, die neueren für unsere Ernährung suggerierten Zusätze einer strengen experimentellen Untersuchung zu unterwerfen, entweder mit den spezifischen Enzymen oder in dem Verdauungskanal selbst oder beides. Denn selbst, wenn es einem fremden Kohlehydrat gelingt, in den Organismus einzutreten, sei es durch sofortige Absorption in verdautem Zustand oder durch parenterale Einführung, so gibt dieses noch keine Garantie dafür, ob er für die ernährende Funktion verwendet wird. Glykogen, Dextrin, lösliche Stärke, Inulin, Saccharose, Laktose werden alle wieder unter solchen Bedingungen ausgeschieden.[2]) Im allgemeinen ist der direkte Beweis der Verwertung der für den Organismus befriedigendste. Denn hier kann jeder mitwirkende Faktor inklusive der noch möglichen Wirkung der Mikroorganismen auf die Kohlehydrate in den beobachteten Resultaten Ausdruck finden. Die Rolle, welche Inulin in der modernen Diät gespielt hat, ist typisch zur Erkenntnis der Notwendigkeit der Untersuchung in den bezeichneten Richtungen. Dieses Polysaccharid kommt sehr viel in den Kompositen vor, in den Knollen der Dahlien, in den verschiedenen Arten des Helianthus, in den Wurzeln der Inula hellenium, der Jerusalem-Artischocke usw. und bildet sofort Lävulose. (Bei Hydrolyse mit verdünnter Säure.) Lävulose wird in dem tierischen Organismus mit Leichtigkeit ausgenutzt und man kann erwarten, daß man mit Inulin dieselben Erfahrungen machen wird. Inulin wird demgemäß schon lange besonders für die Diät der Diabetiker empfohlen, von denen man häufig behauptet, daß sie eine ganz spezielle Toleranz für Lävulose zeigen. Ein sehr bekannter Schriftsteller

[1]) Vgl. Mendel and Mitchell, American journal of physiology 1907, Bd. 20, S. 81.

[2]) Vgl. Mendel and Mitchell, American journal of physiology 1905, Bd. 14, S. 329;

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der Diätlehre gibt folgenden vorsichtigen Rat: »Das Inulin wird, wie Bouchardat zuerst angab, erheblich besser als Stärkemehl vom Diabetiker ausgenützt. Külz bestätigte dies. Immerhin sind die bisherigen Untersuchungen spärlich. Nur für leichte Fälle scheint mir festzustehen, daß Inulin in größeren Mengen vertragen wird als Stärkemehl. Man kann von dieser Erfahrung Gebrauch machen nnd die Patienten auf die obengenannten Gemüse (Jerusalem-Artischocke) hinweisen. Bei schweren Formen von Diabetes ist nach meiner Erfahrung aber doch Vorsicht geboten, obwohl die Versuche von Külz auch in schweren Fällen ein günstiges Resultat gaben.“[1]) Eine Prüfung der Literatur über das physiologische Verhalten des Inulin gibt jedoch wenig Veranlassung zu einem besonders günstigen Urteil betreffs seines Nährwertes. Die Experimente mit Verdauungsenzymen und Sekreten wie Speichel, Magensaft und Eingeweideextrakten haben, fast ohne Ausnahme, gezeigt, daß Inulin von ihnen nicht in Zucker verwandelt wird.[2]) Ein spezifisches Enzym, Inulase, welches fähig ist, die Verwandlung des Inulins in Zucker zu erleichtern, wurde identifiziert und untersucht von Green, Bourquelot und von Dean[3]) im Laboratorium des Verfassers. Es wird von verschiedenen Pilzen gewonnen, wie Penicillium und Aspergillus und versagt, Stärke zu verdauen, wodurch es sich bedeutend von der Amylase unterscheidet. Saiki[4]) ist es gelungen, im Kaninchenserum einen spezifischen Antikörper für Inulase zu finden. Das Enzym hat man niemals in den Sekreten oder Säften der höheren Tiere gefunden. Nicht alle Bakterien sind im Stande, Inulin zu zersetzen, aber es kann durch die freie Mineralsäure des Magensaftes anscheinend hydrolysiert werden. Hierin liegt deutlich die wirksamste Ursache für seine Verwandlung in Zucker im Verdauungstrakt. Vorstehende Betrachtungen erklären zahlreiche charakteristische, auf Experimenten begründete Beobachtungen. So fand Sandmeyer[5]) in den Fäzes über die Hälfte des Inulins wieder, mit dem diabetische Hunde gefüttert worden waren. Miura[6]) und Nakaseko, sowie der Verfasser[7]) konnten keine nennenswerte Bildung von Glykogen bei Kaninchen finden, die mit Inulin gefüttert worden waren, obwohl Lävulose sofort wirkungsvoll in dieser Beziehung eintritt. Die günstigen Berichte über die Verwertung des Inulins stammen fast immer von Beobachtungen bei Diabetikern, bei welchen die Verdauung des Inulins keine korrespondierenden Zuckerausscheidungen in dem Urin veranlaßt hat.

Dies begründete die Annahme, daß der Stoff genügend assimiliert wurde.[8]) Mitchell und ich[9]) haben gefunden, daß wenn Inulin parenteral in den tierischen Organismus eingeführt wird, es wieder ausgeschieden wird, und den weiteren Beweis liefert, daß es nicht die nötigen chemischen Eigenschaften besitzt,

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[1]) von Noorden, v. Leydens Handbuch der Ernährungstherapie 1904, Bd. 2, S. 227.

[2]) Vgl. Komanos, Dissertation, Straßburg 1875; Chittenden, American journal of physiology 1898, Bd. I, S. 17; Richard, Comptes rendus de la société de biologie 1900, Bd. 52, S. 154, Bieri and Portier, ibid. 423; Bierry, ibid., 1905, Bd. 59, S. 256.

[3]) Dean, Botanical Gazette 1903, Bd. 35, S. 24.

[4]) Saiki, Journal of biological chemistry, 1907, Bd. 3, S. 395.

[5]) Sandmeyer, Ztschr. f. Biol., 1894, Bd. 31, S. 12.

[6]) Miura, Ztschr. f. Biol., 1895, Bd. 32, S. 255.

[7]) Mendel and Nakaseko, American journal of physiology, 1900, Bd. 4, S. 245.

[8]) Vgl. Külz, Jahresbericht für Tierchemie, 1874, IV, 455; Teyxeira, ibid., 1905, Bd. 35,

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sich direkt in ernährenden Zucker zu verwandeln. Es ist daher nicht anzunehmen, daß Inulin in irgend einem Maße verwertet werden kann, selbst wenn es unverändert absorbiert wird. Es ist wahrscheinlicher, daß in den Fällen der wenigen klinischen Berichte, welche vorliegen, die Kohlehydratnahrung nicht absorbiert wurde. Die Untersuchung der Fäzes ist gewöhnlich vernachlässigt worden und ohne diese kann die Frage betreffs der Verwertung eines Polysaccharides, zu dessen Verdauung der Körper nicht die wirksamen Mittel besitzt, durch keinen indirekten Beweis beantwortet werden. Infolgedessen scheint es ratsam, die diätetisch-therapeutischen Empfehlungen betreffs Inulin zurückzuhalten, bis dieselben durch vollkommenere experimentelle Beweise gerechtfertigt sind. Eine beträchtliche Menge verschiedener Kohlehydrate findet sich in den Algen und Pilzen und den von der Symbiose dieser Formen gebildeten Flechten. Letztere haben sich Tollens[1]) und seine Schüler zum speziellen Gegenstand ihrer Forschungen gewählt. Gewisse Arten der Flechten, z. B. Cetraria, Evernia prunastris, Usnea barbata liefern charakteristische Kohlehydrate, welche durch Extraktion mit heißem Wasser gewonnen werden und beim Abkühlen gelatinieren. Andere, wie Cladonia rangiferina, Stereocaulon pascale, Peltigera actosa und Cornicularia aculeata liefern solche Polysaccharide nicht, dagegen kommen Mannan, Galactosan, Pentosan und Methylpentosane in verschiedenen Mengenverhältnissen unter diesen Flechten vor. Es wird gewöhnlich angenommen, daß diese Pflanzenformen Nahrung für Tiere bilden. (Daher solche Ausdrücke wie Renntiermoos.) Und es gibt nicht wenige Hinweise betreffs der Verwendung der Flechtenpräparate für die menschliche Nahrung. Schneider gibt in seinem Textbuch über Lichenologie folgenden vorsichtigen Bericht: »Im allgemeinen darf man Flechten wohl als einen Nahrungsstoff ansehen, doch nur in Fällen von Hungersnot oder in solchen Ländern, wo die Zerealien spärlich vorkommen aus dem Grunde, weil alle Flechtenarten einen bitteren Bestandteil enthalten, der dem Geschmack sehr unangenehm ist und schwer zu entfernen bleibt, auch auf den Verdauungstrakt eine schädliche Wirkung ausübt, die eine Art Eingeweideentzündung hervorruft. Von anderen Seiten werden ermutigende Berichte gegeben. So soll ein norwegischer Landwirt kürzlich erklärt haben, daß das Moos dazu bestimmt sei, eine wichtige, volkstümliche Nahrung zu werden wegen seiner Billigkeit und wegen seines Nährgehalts. Das gewöhnliche, grünlichweiße Moos, das man fast überall findet, wird einem chemischen Prozeß unterworfen, gepreßt und gekocht. Es liefert dann selbst dem blasiertesten Epikuräer ein köstliches Gericht und ist vielleicht nahrhafter als die von uns verwendeten Gemüsearten. Es kann auch, gemahlen, als Mehl zum Brotmachen benutzt werden.« Die diätetischen Möglichkeiten dieser Pflanzennährstoffe sind schon lange von den nördlichen Völkern erkannt worden wegen der besonderen agrikulturellen Bedingungen, unter denen sie leben. Obgleich geeignete Getreidearten in diesen Klimaten gedeihen, ist es nicht selten vorgekommen, daß eine besonders strenge Jahreszeit das Reifen der Ernte verhinderte. Die Einwohner waren daher gezwungen, besonders da der Transport von Getreidenahrungsstoffen von außerhalb mit großen Schwierigkeiten verknüpft war,

[1]) Vgl. Ulander, Untersuchungen über die Kohlehydrate der Flechten, Dissertation, Göttingen 05; Ulander und Tollens: Berichte der deutschen chemischen Gesellschaft, 1906, Bd. 39.

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sich auf die Hilfe ihrer nächsten Umgebung zu verlassen und jeden möglichen Ersatz für Brot zu suchen. Man erzählt, daß in solchen Zeiten oft die innere Rinde der Bäume, z. B. des Ahorns, der Birke und der Fichte, nachdem sie von den äußeren harten Ansätzen und dem inneren Saft befreit war, gemahlen und dann mit ein wenig Mehl gemischt zu dem sogenannten »Rindenbrot« verarbeitet wurde. Die Flechten und Moose sind auch in diese Hilfsmittel eingeschlossen.

Tonnen von Algen werden jährlich unter dem Namen Seegras gesammelt und in vielen Teilen der Welt als Nahrung verwertet. Einige dieser Substanzen sind bekannt unter dem Namen Carragen oder Irländisches Moos, Dulse, Laver, Pflanzenleim, das Limu der Hawaibewohner und das Nori, Ranten, Wombu und Wakame der Japaner. Das Fischerei-Bureau der Vereinigten Staaten hat Berichte veröffentlicht, daß die große Anzahl der Algen, welche zu einer »schmackhaften und gesunden Kost hergerichtet werden können« einer gründlichen Untersuchung unterworfen werden sollen. Viele dieser Arten, welche diesem Zweck in Hawai und Japan dienen, befinden sich in unseren Gewässern. Der Seelattich oder grüne Laver (Ulva latissima), der häufig an allen unsern Küsten vorkommt, soll in Schottland wie purple-laver gegessen werden und wird von den indianischen Stämmen der Nordwestküste gegessen. Die »badderlocks« »murlins« oder »henware« (Alaria esculenta), häufig an den Küsten von Neu-England und Kalifornien wird in Schottland gegessen. Dilsea edulis, welches an der Oregonküste vorkommt, wie auch in Europa und Japan, ist ein Nahrungsmittel in Europa; wo es wie Dulse gegessen wird und unter diesem Namen in Großbritanien bekannt ist.[1]) In seiner Abhandlung über die Arten der Seealgen, die in Japan als Nahrungsmittel gebraucht werden, schreibt Oshima[2]) in etwas zurückhaltendem Sinne. »Obgleich die Algen einen gewissen Nährwert haben, werden sie besonders wegen ihres Geschmackes geschätzt. Ihr wirklicher Nutzen beruht zweifellos in der beträchtlichen Menge von mineralischen Salzen, die sie enthalten.«

Wenn man die Ansprüche dieser Produkte »als nährende Substanzen« betrachtet, deren annähernde Analyse ein relativ großes Vorherrschen von Kohlehydraten zeigt, so muß man beachten, daß die letzteren von den gewöhnlich vorgefundenen Zuckern und Stärken abweichen, indem sie durch solche Kohlehydrate ersetzt werden, wie Mannit und Substanzen, die bei der Hydrolyse Galaktose, Mannose, Dextrose, Pentose, Methylpentose usw. geben. Die Ansprüche einer jeden dieser Substanzen als wirklicher Nährstoff müssen geprüft werden. Zuerst müssen wir jedoch wissen, ob der tierische Organismus wirklich im Stande ist, die komplexen Polysaccharide, welche diese einfacheren hydrolytischen Produkte bilden, zu verdauen. Diese Frage hat der Verfasser in seinem Laboratorium zum Gegenstand mehrfacher Beobachtungen gemacht. Unter den Flechten hat vielleicht isländisches Moos (Cetraria islandica)

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[1]) Spezieller Hinweis auf die Literatur über diese Produkte findet sich in H. M. Smith: »The seaweed industries of Japan« und »the utilization of seaweed, in the United states.« Bulletin of the Bureau of fisheries, 1904, Bd. 24, S. 133. Setchell: University of California Publications, Botany, 1905, Bd.2, S. 91 (edible algae and lichens used bys Hawayans). K. Yendo, »Uses of marine algae in Japan« Postelsia 1901; Minnie Reed, The economic seaweeds of Hawaii and

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die meiste Aufmerksamkeit auf experimentellem Wege gefunden. Es liefert leicht zwei in heißem Wasser lösliche Kohlehydrate, wovon das wichtige Lichenin in kaltem Wasser eine opalisierende Lösung, in heißem Wasser eine schwer lösliche Gallerte gibt. Durch Hydrolyse mit Säuren gewinnt man Dextrose, wodurch seine »Dextrosennatur« bewiesen ist. Das zweite lösliche Kohlehydrat wird Licheninstärke oder Isolichenin genannt. Es gibt mit Jod die bekannte blaue Färbung. Dieses Verhalten der zwei Substanzen zusammen läßt ihre nahe Verwandtschaft mit der gewöhnlichen Stärke erraten und die Dextrinnatur der beiden ist damit klar erwiesen.[1]) Die unlöslichen Rückstände der Cetrariaarten geben bei der Hydrolyse mit Säuren Mannose, Pentose und Methylpentose, wodurch das Vorhandensein der sogenannten Hemicellulosen bewiesen wird, zum Unterschiede von den eigentlichen Zellulosen, welche nicht so schnell hydrolysiert werden kann. Diejenigen, welche das Verlangen des Diabetikers nach dem verbotenen Brotstoff kennen und die häufige Azidosis als Resultat der vollkommenen Entziehung der Kohlehydratnahrung bemerkt haben, verstehen die Wichtigkeit der Bemühungen, einen passenden Ersatz zu finden. Die gelegentliche Annahme, die der kritischen Untersuchung nicht Stand hält, daß einige ungebräuchliche Kohlehydrate wie Lävulose, Mannose, Galaktose oder Pentose eine teilweise Verwertung in dem Diabetikerorganismus finden, hat zu vielen unerfüllt gebliebenen Erwartungen in der diätotherapeutischen Lehre des Diabetes geführt und selbst der Erfolg des so viel gepriesenen Hafermehles, der Kartoffel-, Reis- usw.-Diäten beruht noch immer auf einer ziemlich ungewissen Grundlage des direkten Beweises. Unsere Bemühungen nach dieser Seite müssen jedoch energisch durch genaue experimentelle Beobachtungen festgesetzt werden. Külz, der schon lange seine Aufmerksamkeit auf die Möglichkeiten der Verwendung anderer Kohlehydrate als Stärke für die Ernährung der diabetischen Kranken richtete, empfahl den Versuch mit Flechtenbrot, das aus Cetraria islandica[2]) hergestellt werden sollte. Poulsson erwähnt Cantani, daß er therapeutischen Gebrauch von Flechtenbrot bei Diabetes gemacht habe, mit folgenden Worten: »Meine Versuche sind zwar noch nicht abgeschlossen, um mir schon ein Urteil zu erlauben, aber ich glaube doch unter angegebenen Verhältnissen, daß Brot aus Lichenin für die Diabetiker nützlich sein kann.«[3])

Über einen ähnlichen Versuch wird auch von einem norwegischen Arzt, Bugge[4]), berichtet, mit Resultaten, die durchaus nicht überzeugen. Im Jahre 1881 bemerkt Voit[5]) anläßlich einer Beschreibung der Eigenschaften von Moosstärke, daß sie wahrscheinlich durch die Verdauungssäfte in Zucker verwandelt wird, wenn das Lichenin als Nahrungsstoff dient. Die Hartnäckigkeit dieser Behauptung wird

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[1]) Vgl. Brown, American journal of physiology, 1898, Bd. 1, S. 455; Ulander, Untersuchungen über die Kohlenhydrate der Flechten. Dissertation, Göttingen, 1905. Ulander und Tollens: Berichte der deutschen chemischen Gesellschaft, 1906, Bd. 39, S. 401; Müller, Zeitschrift für physiologische Chemie, 1905, Bd. 14, S. 278.

[2]) Külz: Beiträge zur Pathologie und Therapie des Diabetes mellitus. Marburg 1874, S. 145; vgl. Munk und Ewald, Die Ernährung des gesunden und kranken Menschen, 1895, S. 552.

[3]) von Cantani zitiert: Der Diabetes mellitus. Aus dem Italienischen übersetzt von Dr. Siegfried Hahn. Berlin 1877, S. 388.

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in einer kürzlich erschienenen Schrift von Poulsson[1]) wiedergegeben: »Es darf schon im voraus als wahrscheinlich angesehen werden«, schreibt er, »daß Kohlehydrate der angegebenen Natur im Organismus des Menschen zerlegt und ausgenutzt werden. In welchem Umfang dies geschieht, d. h. ob die Enzyme des Darmkanals den Hexosen- und Pentosenanhydriden der Flechten gegenüber ebenso wirksam sind wie heiße Mineralsäuren und in welchem Maßstab Resorption und Verbrennung stattfinden, sind Fragen, die der experimentellen Prüfung bedürfen.«

Die Versuche, Lichenin und Isolichenin mit Hilfe von Verdauungsenzymen in Zucker zu verwandeln, sind allgemein erfolglos gewesen. Die ausführlichsten Studien sind von Nilson[2]) gemacht worden, der gepulverte Flechten und isoliertes Lichenin der Einwirkung von amylolytisch wirksamen Speichel, Magensaft, Bauchspeichelextrakt und verdünntem Alkali unterwarf, ohne erfolgreich die Umwandlung in Zucker beweisen zu können. Brown[3]) bestätigte diese Beobachtungen sowohl bei Lichenin als Isolichenin in des Verfassers Laboratorium, wo eine beginnende Verdauung nur bei dem Isolichenin beobachtet wurde. Er konnte auch keine Glykogenbildung bei Kaninchen nach vorhergegangener Licheninfütterung finden.

Saiki[4]) erreichte positive Resultate nur mit zwei Enzymen vegetabilischen Ursprungs, nämlich Takadiastase von Eurotium oryzae und Inulase von Aspergillus niger. König und Schubert[5]) sollen eine Umbildung von Isolichenin (nicht Lichenin) mit Malzdiastase beobachtet haben.

Die interessante Frage der möglichen Spezifität von Enzymen vegetabilen Ursprungs, die hier angeregt ist, verdient weiteres Studium. Die Rolle der Eingeweidebakterien ist noch kaum untersucht worden.[6]) Die Widerstandsfähigkeit der Lichenkohlehydrate gegenüber den verdauenden amylolytischen Enzymen ist überraschend in Anbetracht des angenommenen Wertes der Produkte als menschliche Nahrung. Wie das Renntier dasselbe verwerten kann, bleibt noch immer ein ungelöstes Rätsel. Diese ungünstigen Verdauungsberichte werden durch die direkten Studien über die Verwertung der Flechtenkohlehydrate im tierischen Organismus bestätigt. Das folgende Protokoll soll als Erläuterung dienen:

III. »Ein kleiner Hund wurde mit Fleisch gefüttert. An zwei Tagen wurde ein Extrakt von Cetraria islandica, 2 % feste Substanz enthaltend in Mengen von 292 ccm und 300 ccm hinzugefügt. Der Kohlehydratinhalt wurde gleich 6,3 g Dextrose geschätzt. Die Exkremente der Flechtenernährungsperiode waren durch Beigabe von feinem Quarz im Anfang der Ernährung und durch Kork vom Anfang der Nachperiode an kenntlich gemacht. In dem Urin wurde kein reduzierender Bestandteil gefunden. Die Zusammensetzung der Fäzes ist nachstehende:

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[1]) Poulsson, Untersuchungen über das Verhalten einiger Flechtenkohlenhydrate im menschlichen Organismus und über die Anwendung derselben bei Diabetes mellitus. Festschrift für Olof Hammarsten, XIV., Upsala, läkareförenings förhandlingar, 1905, XI. Supplement.

[2]) Nilson, Jahresbericht für Tierchemie 1893, Bd. 23. S. 53; vgl. auch Berg, Jahresbericht für Chemie, 1873, S. 848.

[3]) Brown, American journal of physiology, 1898, Bd. 1, S. 455.

[4]) Saiki, Journal of biological chemistry, 1905, Bd. 2, S. 258.

[5]) König und Schubert, Monatshefte für Chemie, 1887, Bd. 8, S. 450

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Zusammensetzung der Fäzes:

| Diät | | Gewicht lufttrocken Gramm | Kohlehydrate wie Dextrose % | Kohlehydrate wie Dextrose Gramm |
|---|---|---|---|---|
| Fleisch | 2 Tage | 10 | 5,8 | 0,68 |
| Fleisch- + Cetraria-Extrakt | „ | 15[1]) | 25,8[1]) | 3,90[1]) |
| Fleisch | „ | 5[1]) | 24,5[1]) | 1,20[1]) |
| Fleisch | „ | 6 | 3,2 | 0,19 |

»Diese Fäzes gehören zu der Cetraria-Ernährungsperiode.«

Bei Experimenten, die man beim Menschen anstellte, wurde Cetraria islandica sorgfältig gereinigt, mit einer verdünnten Lösung von doppelkohlensaurem Kalium extrahiert, um die bitteren Bestandteile zu entfernen, gewaschen, getrocknet und zerkleinert. Es wurde in dieser Form mit einer unverdauliche Kohlehydrate enthaltenden, grünen Vegetabilienmischung vermischt, eingegeben. Die Diät enthielt ihre Kohlehydrate in der Form von feinem weißen Brot und Zwiebäcken. Diese Diät wurde 3 Tage vor der Cetraria-Ernährung begonnen. Das benutzte Präparat enthielt 72,5 % Kohlehydrate als Dextrose. Die Resultate dieses Versuchs und ein zweiter ähnlicher, bei welchem die Nahrung gewogen wurde und jeden Tag gleich war, sind die nachstehenden. Es ist fraglich, ob irgend eine Nutzbarmachung der Cetraria-Kohlehydrate stattgefunden hat.

Cetraria-Ernährung beim Menschen.[1])

| | | Fäzes Gewicht lufttrocken g | Kohlehydrate als Dextrose % | Kohlehydrate als Dextrose g | Bei Cetariagabe |
|---|---|---|---|---|---|
| I. Vorperiode | 3 Tage | 35 | 2,7 | 1 | 80 g = 58 g |
| Cetraria-Periode | 3 Tage | 146 | 38 | 56 | als Dextrose |
| II. Vorperiode | 2 Tage | 68 | 6 | 4 | |
| „ | täglich | 34 | 6 | 2 | |
| Cetraria-Periode | 1 Tag | 53 | 24 | 13 | 20 g = 14½ g |
| Nachperiode | 2 Tage | 29 | 6 | 2 | als Dextrose |

Andere Experimente in unserem Laboratorium haben ähnliche Resultate ergeben. Die Frage, ob vorherige Behandlung der Flechtenkohlehydrate durch Kochverfahren ihre Nutzbarkeit wesentlich verändern würde, soll von meinen Mitarbeitern weiter erforscht werden.

In den vorhergegangenen Protokollen unseres Laboratoriums, deren Details übrigens an anderer Stelle veröffentlicht werden, ist der Ein- und Ausgang der Kohlehydrate direkt durch Hydrolyse der Cetraria-Kohlehydrate und Fäzes und die Bestimmung des entstandenen Zuckers gewichtsanalytisch nach Allihn festgestellt worden. Die Vergleiche beruhen auf als Dextrose berechnetem Zucker. Poulsson[2]) hat zwei Experimente beim Menschen mitgeteilt, wobei die Verwertung des mit Cetraria islandica bereiteten Brotes bestimmt wurde. Ein Verschwinden von 45—49 %, auf die aufgenommenen Kohlehydrate bezogen, wurde konstatiert. So in einem Falle, der als Illustration dienen mag, wo nach

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1) Daten aus den unveröffentlichten Experimenten von Mr. V. C. Myers.

Ernährung mit 300 g Flechtenbrot, das 218 g Kohlehydrate enthalten sollte, die korrespondierenden Fäzes folgende Daten lieferten:

| | |
|---|---|
| Gewicht der Fäzes | 790 g |
| Wasser | 508 g |
| Protein | 42 g |
| Ätherextrakt | 11 g |
| Rohfaser | 10 g |
| Asche | 14 g |
| N-freie Extraktstoffe | 111 g |

Ausnutzung $\frac{218-111}{218} = 49\,\%$

Der Wert der Beobachtung I hängt von den analytischen Daten ab. Hierbei ist zu berücksichtigen, daß die Kohlehydrate (stickstofffreie Extraktsubstanz) in beiden, Flechtenbrot und Exkremente, durch Differenz berechnet und nicht direkt bestimmt wurden.

Ebenso sollten die Fäzes 42 g Protein enthalten (N × 6.25) auf Grund der ganz unwahrscheinlichen Annahme, daß der Stickstoff derselben in dieser Form ganz vorhanden ist. Solch ein Beweis, auf indirekter und ungewisser Kalkulation basierend, erfordert eine genaue Nachprüfung, ehe wir mit dem Autor folgern können: »daß wir in der Isländischen Flechte einen Kohlehydratnährstoff besitzen, der in nördlichen, getreidearmen Ländern die größte Aufmerksamkeit verdient.« Unsere eigene Erfahrung führt zu einem entschieden ungünstigen Urteil. Zwei vorhergegangene Experimente von Poulsson an Diabetikern, die mit Flechtenbrot ernährt wurden, zeigten gar keine Wirkung betreffs der Zuckerausscheidung. Das war eben zu erwarten, wenn die Kohlehydrate unausgenützt blieben. Die Fäzes wurden nicht untersucht, so daß weitere Diskussion jetzt nutzlos ist. Für zahlreiche andere, Kohlehydrate enthaltende Produkte von pflanzlichem Ursprung muß der Hinweis in allgemeinen Ausdrücken gemacht werden. Solche Präparate, wie Gummi arabicum, Holzgummi, Kirschgummi, Salep, Quittenschleim und Pektin, sind schon lange bekannt und nährende Eigenschaften wurden ihnen nicht selten zugesprochen. Einige dieser Produkte haben eine ganz besondere Rolle als Diätmittel bei Kranken gespielt. Die wenigen Beobachtungen, die man gemacht hat, indem man solche Gummis den verdauenden Säften der höheren Tiere aussetzte, haben keine Verwandlung ihrer Polysaccharide in Zucker gezeigt.[1]) Voit versuchte, sich zu vergewissern, wie einige seiner Vorgänger es getan hatten, ob irgendwelche dieser Gummis oder Schleime von dem Verdauungstraktus absorbiert werden können, ohne die vorherige Verdauungstransformation. In dieser Hinsicht wurden Experimente bei Hunden mit Salep, mit Quittenschleim und Gummi gemacht und die Fäzes auf ihre Kohlehydrate hin untersucht. Des Autors Schlüsse entstanden zuerst in Anbetracht der Menge der Exkremente, die nach der Verfütterung beträchtlicher Mengen der Substanzen ausgeschieden wurden. Da die gewonnenen Fäzes von geringerem Gewicht waren, als das verzehrte Produkt, wurde ein gewisser Grad von Verwertung angenommen. Auf diesem Wege folgerte Voit, daß 50 % und mehr von dem Verdauungstrakt absorbiert wurden und daß diese Substanzen »ver-

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mutlich als Nährstoffe bezeichnet werden müssen.« Betreffs des Mechanismus, durch welchen sie nutzbar gemacht werden mochten, konnte in Anbetracht der großen Unverdaulichkeit des untersuchten Schleimes nichts anderes angenommen werden, als die Möglichkeit der Zersetzung durch Bakterien. Gibt man zu, daß ein Teil der Nahrung verschwindet, so ist keineswegs damit bewiesen, daß die unverdaulichen Kohlehydrate in dem fehlenden Teil eingeschlossen waren. Ein wertvolleres und überzeugenderes Verfahren wäre gewesen, diese Bestandteile quantitativ in den Verdauungsprozeß einzuführen und die Exkrete zu bestimmen. Diese Methode ist in des Verfassers Laboratorium angewendet worden und Dr. Saiki hat bereits von einigen Beobachtungen berichtet, betreffs der Verwertung der Kohlehydrate bei Algenpräparaten. Das größte Interesse unter diesen besitzt Agar-Agar, der einigen Ruf als Nahrungsmittel genießt, besonders in vegetarischen Kreisen unter dem Namen »vegetabilische Gelatine« und auch in Japan unter dem Namen »Kanten«[1]) Anwendung findet als Nahrungsmittel in der Form von Gelee, als Zutat zu Suppen und Saucen. Es wird aus Algen der Gelidiumart hergestellt und der etwa 60 %ige Gehalt an Kohlehydrat, den er besitzt, besteht hauptsächlich aus Galaktosanen und Pentosanen.[2]) Ein weiteres Lieblingspräparat ist «Kombu», von einer Art der Laminaria herrührend, welches zu dem Nahrungsregime einer jeden japanischen Familie gehört. Es dient als Gemüse und wird auch anderer Speise beigekocht, um dieser Geschmack zu geben. 10 bis 20 Gramm werden auf diese Weise täglich gebraucht. Hierzu gehört auch »Amanori« oder Laver, welches von Porphyra hergestellt und vielfach in der Ernährung verwandt wird, aber in kleineren Quantitäten. Ebenso wird »Wakame« von Undaria pinnatifida hergestellt und ist den Produkten ähnlich, die von den Schotten und Iren gebraucht werden. Diese und viele andere Arten sind in den verschiedenen Limuarten enthalten, die man auf den Hawaiischen Märkten zur Bereitung der weißen Gelatine, Suppen, gekochtem Fleisch und Saucen verkauft und den Pickles, Konserven oder Süßigkeiten beifügt. Studien der Nutzbarmachung dieser Produkte, wie wir sie bereits in unserem Laboratorium ausgeführt haben, zeigen eine sehr unbefriedigende Verwertung der konstituierenden Kohlehydrate, die kaum von den gewöhnlichen Verdauungsenzymen angegriffen werden oder wesentlich von solchen bakterischen Einflüssen verändert werden, wie man sie im Verdauungstrakt des Menschen annehmen kann. Einige wenige dieser Protokolle über Experimente, die Saiki am Menschen machte und bei welchen die Fäkal-Kohlehydrate direkt durch die Analyse bestimmt wurden, mögen als Erläuterung dienen. Die tägliche Diät bestand aus:

| | |
|---|---|
| Beef-steak | 513 g |
| Brot | 500—600 g |
| Zucker | 40 g |
| Butter | 31 g |
| 3 Eiern | |
| 2 Äpfeln | |

In wechselnden Perioden wurden die Algenpräparate in gekochter Form

[1]) Saiki, Journal of biological chemistry, 1906, Bd. 2, S. 251.

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hinzugefügt, die Quantität auf die drei Mahlzeiten verteilt. Stickstoffbestimmungen wurden nach der Kjeldahl-Gurning Methode ausgeführt.

Versuche über die Verwertung beim Menschen.

| Der Diät beigemischte Substanzen | Harn: Volumen ccm | Harn: Spezifisches Gewicht | Harn: Stickstoff Gramm | Faeces: Gewicht feucht Gramm | Faeces: Gewicht lufttrocken Gramm | Faeces: Stickstoff lufttrocken Gramm | Faeces: Stickstoff lufttrocken % | Faeces: Kohlehydrate (als Dextrose) lufttrocken Gramm | Faeces: Kohlehydrate (als Dextrose) lufttrocken % |
|---|---|---|---|---|---|---|---|---|---|
| Agar-Agar 19 g | 1275 | 1,027 | 20,3 | 313 | 62 | 4,1 | 6,6 | 8,8 | 14,4 |
| „ „ 5 g | 1450 | 1,026 | 24,8 | | | | | | |
| nichts | 1315 | 1,026 | 24,3 | 222 | 46 | 3,6 | 7,7 | 0,7 | 1,5 |
| „ | 1930 | 1,017 | 25,7 | | | | | | |
| Wakame 20 g | 1570 | 1,025 | 24,8 | 321 | 70 | 4,9 | 7,0 | 3,4 | 4,8 |
| „ 20 g | 1600 | 1,026 | 26,6 | | | | | | |
| nichts | 1600 | 1,028 | 23,5 | 275 | 55 | 4,4 | 8,0 | 0,7 | 1,4 |
| „ | 1440 | 1,026 | 25,3 | | | | | | |
| Asakusanori 6 g | 1530 | 1,024 | 23,7 | 207 | 52 | 4,3 | 8,3 | Spur | 0,1 |
| „ 6 g | 1615 | 1,025 | 23,1 | | | | | | |
| nichts | 1400 | 1,024 | 23,4 | 171 | 43 | 3,4 | 8,0 | Spur | 0,1 |
| „ | 1255 | 1,025 | 22,8 | | | | | | |
| Kombu 25 g | 1650 | 1,024 | 25,4 | 234 | 59 | 4,7 | 8,0 | 2,5 | 4,2 |
| „ 20 g | 1610 | 1,024 | 25,7 | | | | | | |
| nichts | 1810 | 1,023 | 23,4 | 168 | 41 | 3,9 | 9,6 | Spur | 0,1 |
| „ | 1460 | 1,025 | 24,8 | | | | | | |
| Italienische rohe Kastanien 150 g | 1495 | 1,024 | 24,8 | 233 | 29 | 2.0 | 7,0 | 4,9 | 16,9 |
| „ 68 g | 1420 | 1,025 | 24,7 | 76 | 21 | 1,8 | 8,5 | 0,7 | 3,2 |

Der Versuch mit ungekochten Kastanien wurde angestellt, um die Wirkung roher Stärke auf die Zusammensetzung der Fäzes im Vergleich zu Algenkohlehydraten zu bestimmen. Die Resultate zeigen die relative Unverdaulichkeit der in dieser Form gereichten Stärke.

Diese Forschungen stimmen mit den Berechnungen von Oshima[1]) überein betreffs der Nutzbarmachung der Nahrungsstoffe der japanischen Kost, die reich an Algenpräparaten ist. Während die Kohlehydrate gewöhnlich bis zu 98% verwertet werden, findet man folgende Daten bei Mischung mit Algen.

| See-Algen | Verdaulichkeitskoeffizient: Kohlehydrate und Rohfaser | Verdaulichkeitskoeffizient: Rohfaser |
|---|---|---|
| Ecklonia bicyclis | 36,2 | 17,8 |
| Laminaria sp. | 75,2 | 55,3 |
| Laminaria sp. | 55,0 | 65,4 |
| Ulopteryx pinnatifida | 72,3 | 2,3 |

Bei den Experimenten, in welchen Agar-Agar von uns angewendet wurde, konnte es mit Leichtigkeit in den Fäzes wiedergefunden werden. Die Wirkung

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auf die Gesamtmasse der Fäzes war bemerkenswert. Agar hält leicht Wasser in den Ernährungsrückständen zurück und verhindert die Bildung von harten Fäkalmassen (scybala), die so charakteristisch in den gewöhnlichen Formen der Verstopfung sind. Diese Eigenschaft, welche dem Rektalinhalt eine weiche Beschaffenheit gibt, zusammen mit dem Widerstand gegen bakterielle Zersetzung und der dadurch entstehenden Produktion von Gasen oder anderen schädlichen, unvollkommen zersetzten chronischen Produkten, läßt den Verfasser vermuten, daß Agar-Agar in der Diätotherapie von Nutzen ist bei geeigneten Fällen chronischer Verstopfung. Dieselbe Empfehlung gibt Ad. Schmidt.[2]) Getrocknet, in geringem Maße genommen, wie die bekannte Getreide-Frühstücksnahrung kann Agar-Agar in Quantitäten bis 25 g täglich, zwischen zwei Mahlzeiten verteilt, genommen werden mit Sauce, Sahne usw. als schmackhafte, wohlschmeckende Zugabe. Diese Behandlung wird natürlich nicht angewandt, wenn die motorischen Funktionen des Verdauungstraktes gestört sind. Bei älteren Personen mit geschwächten Eingeweiden ist mir durch Ärzte, welche die oben erwähnte Vermutung geprüft haben, berichtet worden, daß die Agarernährung unwirksam ist. Bei kleinen Kindern ist die Anwendung von Agar-Agar ebenfalls nicht anzuraten. Aber bei den chronischen Fällen, die man so häufig findet, wo der wesentliche Faktor der Verstopfung in einer außergewöhnlich vollkommenen Verdauung und vollkommenen Absorbierung des Wassers aus dem Darminhalt besteht, sind günstige Resultate bei fortgesetztem Gebrauch von Agar, in Fällen unter meiner Beobachtung erzielt worden und bei einigen, wo Gelegenheit gegeben war, die Fortsetzung der diätetischen Behandlung zu überwachen, konnte die tägliche Aufnahme beträchtlich vermindert werden, da die Entleerungen mit befriedigender Häufigkeit und Leichtigkeit erfolgten. In Anbetracht dieser Tatsachen ist es nicht unwahrscheinlich, daß viele der Algenprodukte, welche diätetisch verwendet wurden, so gelobt werden wegen ihrer milden laxativen Tätigkeit infolge ihrer Unverdaulichkeit und der Leichtigkeit, mit welcher sie Feuchtigkeit zurückhalten. Mannane, die Hemizellulosen, welche bei der Hydrolyse Mannose geben, werden von den Japanern aus den Knollen von Hydrosoma rivieri (Conophallus Konjak) gewonnen, und gewöhnlich in gekochter Form unter dem Namen Konnyaku verzehrt. Das Präparat enthält keine Stärke.[2])

Die Forschungen von Storer und Dillingham[3]) haben gezeigt, daß Mannan sich in der inneren Rinde verschiedener Bäume findet, aber nicht in solcher Menge, um den Gebrauch der Borke (von Koniferen) als Nahrung in Form von Rindenbrot, wie im vorhergehenden erwähnt wurde, zu empfehlen. Dillingham hat interessante Details in seinem Beitrag zur Geschichte des Nutzens des Rindenbrotes gesammelt. Er stellte fest, daß die Rinde des Staff-Baumes, Celasters (Celastrus scandens), auch Bittersüß genannt, kletternde Orangenwurzel und

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[1]) Schmidt, Münchener medizinische Wochenschrift, S. 1905, 1970. Auf diese Anregungen hin wurden Agarpräparate unter Handelsmarken eingeführt »Regulin« ist Agar-Agar mit wässerigem Extrakt von Cascara sagrada imprägniert »Collax« und »Laxative biscuits« sind anscheinend ebenreich an Agar-Agar oder derartiger Substanz.

Vgl. auch. Mollweide, Erfahrungen über Regulin; Therapeutische Monatsschrift, 1906, S. 126.

[2]) Vgl. Tsuji, Bulletin of the College of Agriculture. Tokio, 1894 Bd. 2. No. 1.

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Jakobsleiter eine Unmenge von Mannan enthalten. Die zarten Zweige und die Rinde dieses Kletterstrauches waren es, die von einigen Stämmen der nordamerikanischen Indianer häufig gekocht und gegessen wurden in Zeiten der größten Not. Der mögliche physiologische Wert solcher Rindenprodukte ist daher dem Vorhandensein von Mannan zuzuschreiben. Die einzige direkte Untersuchung, die dem Schreiber dieses bekannt ist, hat gezeigt, daß weder künstliche gastrische Extrakte, noch die Bauchspeichel- oder Eingeweide-Enzyme des Schweines fähig sind, die Mannane des Konnyaku[1]) zu verdauen. Daher mutmaßt man, daß ihr wirklicher Wert in der Diät auf ihrer Wirkung hinsichtlich der Entleerung der Exkremente beruht. Die physiologische Rolle der Pentosane und des von demselben abgeleiteten Pentosezuckers ist noch immer zum größten Teil ein Gegenstand der Mutmaßung.

Die Literatur ist von Neuberg[2]) gründlich revidiert worden. Es ist klar, daß die Pentosane, wenn überhaupt, viel weniger schnell von den Eingeweiden des Menschen verwertet werden als von den Pflanzenfressern. Eben bei den letzteren bleibt der wahre Nahrungswert so schwer verdaulicher gärungsfähiger Produkte problematisch.[3]) Ein hoher Grad der Assimilation besteht sicher nicht, und kürzliche Untersuchungen von Brasch[4]) geben keinen Aufschluß über die Verdaulichkeit von Galaktose oder von Pentosen, (Arabinose, Xylose, Rhamnose) in der diätetischen Behandlung des Diabetes. Die Bedeutung der Zellulose muß mit der gleichen Vorsicht ausgelegt werden. Dies ist kürzlich von Lorisch[5]) ausgesprochen worden. Dieser Forscher hat nachgewiesen, daß die sogenannte Zellulose unserer gewöhnlichen vegetabilen Nahrung in beträchtlichen Mengen aus den Eingeweiden verschwindet. Er neigt zu der Ansicht, daß die Lösung von Polysacchariden nicht ausschließlich durch fermentative Wirkungen des Organismus bedingt wird. Schmidt und Lorisch[6]) haben ein Verschwinden von speziell hergestellter Kohlzellulose beim diabetischen Kranken ohne Elimination des Zuckers konstatiert. Sie glauben, daß der Hauptteil in irgend einer lösbaren Form absorbiert wird und nicht durch Gärung im Darm verloren wird. Es ist jedoch zu früh, die Erfüllung irgend einer befriedigenden, ernährenden Wirkung auf diese Weise (wie durch unkritische Autoren geschehen) vorherzusagen. Die Energie erzeugende Fähigkeit der nicht wieder gefundenen Zellulose in dem Organismus selbst muß noch nachgewiesen werden und Lorisch selbst hat die Daten unter gebührendem Vorbehalt gegeben. Hier seine eigenen Worte: »Die Mengen Zellulose, die der Mensch mit der gewöhnlichen gemischten Kost einführt und die damit aufgenommenen Energiemengen sind allerdings so klein, daß die Zellulose als Nahrungsmittel für den gesunden Menschen kaum jemals in Betracht kommen wird.« (loc. cit. S. 815.)

Das Resultat dieser Untersuchungen liegt in dem Hinweis auf genügende Verdauung als Vorbedingung für die physiologische Nutzbarmachung der Kohlehydrate, und auf den hohen Wert einiger weniger spezifischer Kohlehydrate.

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[1]) Vgl. Gatin und Gatin, Biochemisches Centralblatt, 1907, Bd. 6, S. 801; Chemical Abstracts, 1908, Bd. 2, S. 294.

[2]) Neuberg, Ergebnisse der Physiologie, 1904, Bd. 3 (2), S. 412.

[3]) Vgl. Slowtzoff, Zeitschrift für physiologische Chemie 1901, Bd. 34, S. 181.

[4]) Brasch, Zeitschrift für Biologie, 1907, Bd. 1, S. 113.

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Die Lehren der Experimente warnen vor der eiligen Aufnahme jedes Kohlehydratnahrungsproduktes in die Kategorie wahrer Nahrungsmittel. Wir müssen auf der Grundlage von exakten Stoffwechselversuchen bauen. Viele der modernen Produkte haben zweifellos einen verdienten Platz in der Diätlehre bei Gesunden und Kranken als Nahrungshilfsmittel, ganz abgesehen von einer direkt ernährenden Funktion. Was von den Kohlehydratbestandteilen bekannt ist, gilt in Fällen auch für andere Komponenten. So wird behauptet, daß einige der Algen, die reich an Stickstoff sind (z. B. Porphyra) besonderen Wert besitzen wegen ihres Proteingehaltes. Das Letztere ist jedoch eine aus dem N-Gehalt gefolgerte Annahme. Des Verfassers Erfahrung mit Pilzen, bei welchen der Stickstoff sich in reichem Maße unter der Form von unverwertbaren Nichteiweißverbindungen fand[1]), lehrt weitere Vorsicht, solche Pflanzenprodukte auf ihren ernährenden Wert zu taxieren. Vielleicht ist die Tatsache, daß so wenige der suggerierten Nahrungsmittel, die in dieser Zusammenstellung erwähnt wurden, irgend eine allgemeine Anerkennung gefunden haben, obwohl sie in der Natur soviel verbreitet sind, beinahe als instinktiver Ausdruck ihrer Nichtnahrhaftigkeit anzusehen. Der aufmerksame Leser wird nicht versäumt haben, den Weg gewiesen zu sehen für zahllose ungelöste Probleme, welche noch der Aufklärung harren. Inmitten der Ungewißheit erlangt man etwas Mut durch die Worte von Donders: »Wer mit aller ihm innewohnenden Kraft an der Entwicklung dieser Kenntnisse arbeitet und mit Ausdauer den Resultaten seiner Untersuchung Eingang zu verschaffen bestrebt ist, der arbeitet auf breiter Basis an der Entwicklung der Menschheit.«

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[1]) Mendel, American journal of physiology 1898, Bd. 1, S. 225.

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## DISCUSSION.

Dr. Max Einhorn, New York: With regard to agar, it depends upon the strength in which it is given. If you take a 1% solution of agar, which remains solid at blood temperature, that disappears, but if you take a solution which contains 50% of agar, that passes unchanged, but it becomes imbibed with fluids. The bacteria do not penetrate into the interior of the agar, which strengthens the view of Dr. Mendel. The dry agar, as sold in the market, will pass unchanged, although it may have an accessory mechanical effect.

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[Reprint from The Cleveland Medical Journal, August, 1908]

# The Nervous Control of the Production of Sugar in the Animal Body

By. J. J. R. MACLEOD.

The remarkable discoveries by von Mering and Minkowski of pancreatic and phlorizin diabetes have, in recent years, tended to throw into the shade those forms of experimental glycosuria which have been considered to depend on some change in the central nervous system. The so-called puncture diabetes and the reflex glycosurias of Claude Bernard and Eckhard have scarcely received any attention by investigators within recent years.

For sometime past we have been engaged in my laboratory in researches dealing with a study of this latter phase of the subject, or more particularly with the amount of reducing substance in the blood and urine as influenced by the stimulation of various afferent and efferent nerves. Although the subject is one which can in the stricter sense scarcely be called gastro-enterological, yet I believe that some of the results may be of interest to such a society as this, especially since the mechanism involved in bringing about changes in the production of dextrose in the animal body resides, in large part, in the glycogenic function of the liver.

I should perhaps further state, by way of preface, that in his well-known monograph on carbohydrate metabolism, entitled "Das Glykogen," Pflüger* has clearly brought out the fact that there are many forms of glycosuria, experimentally induced by partial removal of the pancreas, which, when carefully studied, exhibit no features warranting their being considered as of

*Pflüger: Das Glykogen. Bonn, 1906.

*Read before the American Gastro-Enterological Association at Chicago, Ill., June 1, 1908*

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closer relationship to the severe diabetes which follows complete pancreatic extirpation than to that produced through the nervous system. Indeed, Pflüger would go further even than this, for he believes that the diabetes following complete depancreatation is not essentially different from that induced through the nervous system.

The part of my researches which I have chosen for the present communication concerns the existence in the greater splanchnic nerves and fibres which control the production of reducing substance by the liver. That direct stimulation of this nerve has any effect in producing glycosuria was denied by Eckhard,* although he and others noted, after section of the splanchnics on both sides, that piqûre was not followed by the usual glycosuria. The Cavazzani brothers,† however, found that stimulation of the cœliac plexus caused a marked rise in the reducing power of the blood of the hepatic vein, and a great reduction in the amount of glycogen in the liver.

In my first experiments, the splanchnic nerves were cut on both sides and the peripheral end of one then stimulated by the induced current: no hyperglycæmia was found to result. It had, however, previously been noted by me when the mean arterial blood-pressure has been lowered from any cause, that it is impossible to obtain constant results regarding the percentage of reducing substance in the blood and, naturally, section of the splanchnic nerves produces a marked fall in blood-pressure.

It was then decided to try the effect of stimulation of the splanchnic nerve on one side (the left) without cutting either nerve. In fourteen (14) experiments of this nature, the reducing power of the blood was found markedly raised in eleven (11) but not affected in the remaining three (3). In some cases the increase in reducing power was very striking, *e. g.*, up to 0.433 percent, while in others a less marked hyperglycæmia was obtained. The above result was noted in about 30 minutes after commencing stimulation of the nerve.

Observations were also made on the urine, particularly its rate of formation and its percentage reducing power. It was found, in most cases, that both of these increased parallel with

*Eckhard; Beiträge, 1869, IV, p. 4.

†Cavazzani: Archiv für die gesammte Physiologie, 1894, LVII, p. 181; Cavazzani frères: Archives Italiennes de Biologie, 1893, XIX, p. 270.

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the reducing power of the blood, as is shown in the curves plotted from a typical experiment, and given in Fig. 1.

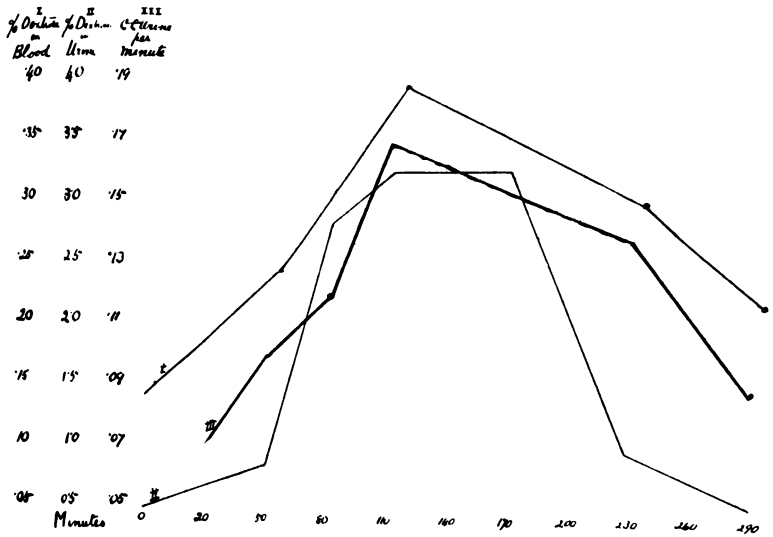


FIG. I.

The above result led naturally to the next step in the investigation, viz., *the exact nature of the fibres in the great splanchnic nerve concerned in the regulation of sugar production by the liver.*

It is conceivable that the hyperglycæmia produced by stimulation of these nerves might be accounted for by:

1. Afferent stimulation (possibly through the vagi) of the medullary centers controlling the respiratory movements; or, of the so-called diabetic center.

2. Stimulation of vasomotor (constrictor) fibres, leading to disturbances in the hepatic circulation.

3. Stimulation of secretory fibres regulating the production or activity of *glycogenase* in the liver.

We shall now very briefly proceed to discuss each of the possibilities.

## I. STIMULATION OF AFFERENT FIBRES CONNECTING WITH THE MEDULLARY CENTERS

It is a well known fact that stimulation of the great splanchnic nerve in the region of the suprarenal capsule frequently affects the respiratory movements. Such interference may sometimes itself be followed by hyperglycæmia and in this way, as I have shown,* is to be explained the hyperglycæmia following

*Macleod: The American Journal of Physiology, XIX, 1907, p. 388.

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stimulation of the central ends of nerves, such as the vagus, which contain afferent respiratory fibres. The hyperglycæmia thus induced can, however, be invariably prevented by ventilating the lungs with pure oxygen gas; whereas, such a procedure does not prevent the increase in reducing power of the blood as a result of stimulation of the splanchnic nerve. It must be pointed out, however, that although it does not prevent the hyperglycæmia, yet in animals thus treated the hyperglycæmia is commonly not so marked as otherwise.

When the hepatic branches of the cœliac plexus are cut and the splanchnic nerve then stimulated no hyperglycæmia is found to result, although in such cases the effect on the respiratory movements occurs as readily as if these nerves had been intact. In considering this experiment as evidence against the afferent nature of the fibres, it must, of course, be borne in mind that all nerve connections to the liver have been severed and that, therefore, the glycogenolytic function of this organ has been removed from under nervous control. It is commonly believed, however, that respiratory interference leads to hyperglycæmia more probably by disturbing dextrose consumption than by causing an increased output from the liver.* Since, however, this is not as yet an established fact, the above proof must be considered as provisional.

Stimulation of the peripheral ends of the cut hepatic nerves causes marked hyperglycæmia in 50% of the cases. The negative results in half the cases are to be accounted for by the fact that, in my experiments, no attempt was made to dissect out the individual nerve fibers, but the electrodes were tied around the mass of nerve-containing connective tissue running to the hilus of the liver after it had been dissected free from the portal vein and cut between mass ligatures. In certain cases therefore most, if not all, of the electric current must have been short circuited through connective tissue. For purposes of the above argument, however, a positive result in half of the cases is sufficient to warrant the conclusion that the hepatic nerves contain efferent fibres which influence the sugar production in the liver and this fact lends support to the belief that the fibres in the great splanchnic nerve are of similar nature.

### II. STIMULATION OF VASOMOTOR FIBRES LEADING TO DISTURBANCE IN THE HEPATIC CIRCULATION

However produced, asphyxia is associated with hyperglycæmia. Thus, as explained above, interference with the respira-

*Underhill: Journal of Biological Chemistry, Vol. I, p. 126, 1905-06.

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tory movements by stimulation of sensory nerve fibres causes it, as do also such drugs as nicotin, pipiridin, ether, morphin, etc., which act on the respiratory center. Disregarding, for the present, the exact mechanism leading to this result of asphyxia, we may nevertheless admit the possibility that a local asphyxia of the liver would likewise cause an abnormally rapid glycogenolysis with a consequent hyperglycæmia. Such a local asphyxia of the hepatic lobule would, of course, follow constriction of the supplying blood-vessels, and by means of such a mechanism as this, it might be, that splanchnic stimulation causes hyperglycæmia.

That such, however, is not the case, I have shown by the study of the behavior of the reducing power of the blood after ligation of the hepatic artery, and after temporary clamping of the portal vein. By neither of these operations is hyperglycæmia induced, unless when, in the latter case, the vein is clamped for longer periods of time than two minutes. Under these latter circumstances hyperglycæmia follows, but the marked lowering of arterial blood-pressure which results from prolonged clamping is, as explained above, an interfering factor, so that the experiments in which the clamping is for so long a period of time are not of very much value in connection with the present discussion. The establishment of an Eck fistula (anastomosis of the portal vein to the inferior vena cava) is not followed by glycosuria* nor does thrombosis of the portal vein have such a result. It may seem to you inconsistent that prolonged clamping of the portal vein should cause hyperglycæmia, whereas complete removal of the portal blood from the liver, as is brought about by Eck's operation, should not do so. A little consideration of the exact conditions in the two cases, however, offers a satisfactory explanation; for, in the one of these (*i. e.,* temporary clamping of the vein) the sugar which has accumulated in the liver as a result of prolonged removal of the portal blood is immediately afterwards flushed into the systemic circulation: whereas, in the other (*i. e.,* Eck fistula), such is not the case, the sugar being so gradually removed from the liver that it does not overwhelm the blood and therefore does not cause hyperglycæmia.

By a process of exclusion, therefore, we are driven to conclude that the nature of the above fibres in the great splanchnic nerves must be secretory. They must be fibres which control

*Macleod: Art. "Eck's fistula"; Pathological Studies. Quatercentenary Publications, Aberdeen University, 1905.

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the production or the activity of glycogenase, the amylolytic ferment of the liver. It is, of course, a very difficult matter to furnish direct evidence of the truth of this conclusion. In the case of glands such as the salivary and gastric, whose activities are undoubtedly to a large extent under nervous control, observations on the rate of secretion is all that is necessary to furnish the desired evidence, but in the case of glycogenase production by the liver, we are compelled to judge of its rate of production by the effect which it has in influencing the output of dextrose by this organ.

Many secretory mechanisms under nervous control are paralyzed by the administration of atropin. I have found, however, that atropin does not interfere with the above described effect of stimulation of the splanchnic nerve. Such a result cannot, of course, be taken as negative evidence of the existence of glycogenase secretory fibers, for the mechanism here involved is more akin to that of a ductless gland, on the supposed secretions of which atropin has no effect.

It was further attempted to decide the question by making a comparison of the amount of glycogen in the liver of the turtle before and after stimulating the spinal cord. In the large snapping turtle the liver is of large size and consists of two lobes joined together by a narrow bridge of liver substance. One of these lobes was, first of all, removed, a shoe lace being tied around the stump as a mass ligature to prevent hemorrhage, and its glycogen content determined by the method of Pflüger.* The spinal cord was then stimulated with the faradic current for one hour, after which the glycogen was determined in the remaining portion of liver. No conclusive results could, however, be obtained.

Finally, experiments were conducted dealing with the glycogen content of portions of the liver of the dog removed after anastomosing the portal vein to the inferior vena cava. By diverting the portal blood in this way, very little hæmorrhage attends removal of a lobe of liver, provided that the stump be enclosed in a flat mass ligature (shoe lace). In one series of observations, the glycogen was determined by Pflüger's method, in a piece of liver (about 20 gr.) removed immediately after making the fistula and in another piece removed one hour later. In another series of observations, the great splanchnic was stimulated in the interval between removal of the two pieces of liver. It was found that when the anastomosis had been readily estab-

*Pflüger: Archiv. f. d. ges. Physiologie. Bd. CXIV, S. 231, 1906.

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lished, and the blood-pressure had recovered well after the operation, that with no stimulation of the splanchnic nerve the percentage rate of glycogenolysis in one hour in two experiments was 24.3 and 22.6.* In two other experiments without stimulation, but in which there was low mean arterial blood-pressure after establishment of the anastomosis, the percentage rate of glycogenolysis was 40 and 74.1. In four experiments in which the splanchnic nerve was stimulated for one hour after making the anastomosis, the percentage rate of glycogenolysis was 70, 100, 89.2, 83.1 and 39.4 and in one experiment in which the first piece of liver was removed in one-half hour after making the anastomosis, and the second in one-half hour later—during which time the nerve was stimulated—the above value stood at 50.8.

It will be seen that a distinctly more rapid disappearance of glycogen occurred when the nerve was stimulated.

The only circulation through the liver in these experiments is that of the hepatic artery. When the mean arterial blood-pressure is greatly lowered by the operation, then the hepatic artery blood-supply is insufficient to prevent a glycogenolysis similar to that seen immediately after death (postmortem glycogenolysis). In such cases, therefore, a high percentage glycogenolysis is observed in one hour. With good blood-pressure on the other hand, the hepatic arterial blood-supply is sufficient to prevent the advent of postmortem glycogenolysis and a low percentage change is observed.

When with good blood-pressure the splanchnic nerve is stimulated there will result a constriction of the hepatic artery which, according to the above argument, must, by diminishing the arterial blood-supply to the liver, tend to accelerate glycogenolysis. In our results, however, the rate of this has been found, on an average, distinctly greater when the splanchnic nerves were stimulated in animals with good blood-pressure than it is in those cases with low arterial blood-pressure but no stimulation of the splanchnic nerve; which fact, can, of course, mean only one thing, viz., the presence of true glycogenase secretory fibers in the greater splanchnic nerve.

These last mentioned experiments present, however, one serious fault, viz., that the rate of glycogenolysis in the liver in the stimulated cases is compared with this rate in the liver of

*This value is obtained by subtracting the percentage amount of glycogen found in the second piece of liver from that found in the first piece, and then calculating this value as percentage of the amount found in the first piece of liver.

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another animal in which no stimulation is practised. It might be claimed that the differences observed are merely accidental, since the rate of glycogenolysis varies greatly in the livers of different animals. We are at present engaged in another type of experiment which will remove this objection, but the results are not yet ready for publication. After establishing the Eck fistula, a piece of liver is removed; the animal is left undisturbed for 30 minutes when another piece of liver is removed, the splanchnic nerve is then stimulated for another 30 minutes, at the end of which time a third piece of liver is removed. Glycogen estimations are made on the three pieces of liver and the rate of its disappearance compared for the first or resting half hour and for the second or stimulated half hour.

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[Reprint from *American Medicine*, New Series, Vol. III, No. 11, pages 514-520, November, 1908.]

# INDICANURIA.*

BY

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As far back as medical literature goes it has been known that the intestines were capable of elaborating poisons which produce widespread systemic morbid processes; hence purgation was one of the earliest methods of treatment and throughout all time has held a prominent place in the relief of bodily ailments. With the onward march of medical knowledge some advance has been made in differentiating the various forms of intestinal intoxications, both as to the abnormal chemical processes involved and the clinical phenomena produced.

Among the abnormal intestinal processes resulting in the formation of toxic substances is putrefaction, by which in the restricted sense is meant abnormal transformation of proteid material under the action of bacteria, especially of a group of anaerobic bacilli in the lower intestines.

[1] Read before the American Gastro-Enterological Association at its Eleventh Annual meeting, held at Chicago May 1 and 2, 1908.

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Various toxic substances are thus formed, such as indol, skatol, phenol, and others. These products may be partially absorbed into the circulation even from the colon, which has usually been supposed to be resistant to this absorption, and in circulating through the body give rise to many morbid manifestations before being eliminated by the kidneys.

They enter into chemical combination as the conjugate or ethereal sulphates and glycuronates, and circulate and are excreted as such. Thus, indol is oxidized and unites with potassium sulphate to form a double or conjugate indoxyl-potassium sulphate, the urinary indican. Similar sulphates are formed by the other putrefactive bases, and conjugate glycuronates are produced in similar manner.

Although theoretically the putrefaction and absorption of the putrefactive products may be abnormal, yet under the practical conditions of life small amounts of these substances are produced, absorbed, and excreted without causing any material ill effects. Their presence in the system in these small amounts may be looked upon as normal; when present in larger amounts, however, they may produce toxic manifestations. Their action in this respect may be very subtle and obscure, and a variety of morbid conditions of a functional character in remote parts of the body and apparently

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unrelated to intestinal conditions may be set up. In obscure cases of this sort, therefore, it becomes important to have some means of measuring intestinal putrefaction in order to determine what bearing the latter may have upon the clinical symptoms and thus to further therapeutic efficiency.

Unfortunately our means of estimating intestinal putrefaction or absorption of putrefactive products are incomplete.

One method consists in the determination of the relative ratio of the conjugate to the mineral sulphates in the urine. Normally the ratio is about 1 to 9; an increase of the conjugate sulphates indicates increased putrefaction of the proteids. This method is too laborious for routine clinical use, and, further, is not always entirely conclusive, as it leaves out of account the putrefactive bases excreted in combination with glycuronic acid and also the variations of sulphur metabolism. Other equally tedious methods consist in the determination of phenol, cresol, etc., in the urine. Other diagnostic tests which may possibly prove to be indicative of increased putrefaction are the dimethylamidobenzaldehyde and urorosein (indolacetic acid) tests.

Still another method, which is in extensive use, is the approximate determination of indican in the urine. The presence of

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an abnormal amount of indican in the urine (to which condition the term indicanuria is applied) can be ascertained by simple tests. The test gives no information as to other putrefactive products besides indoxyl-potassium sulphate,—and probably putrefactive toxemia is possible without the indican being increased. But as indican is ordinarily the most abundant of the putrefactive products indicanuria is an important index of the occurrence of intestinal putrefaction.

Besides the putrefaction of the food in the alimentary tract, putrefactive products may be generated from the tissues of the body in necrotic conditions, putrid, stagnant, and chronic suppurations, etc. These sources of indican are exceptional, and after excluding them, indicanuria may be definitely accepted as an indication of the excessive putrefaction of proteid food in the intestines; although the absence of indicanuria does not necessarily disprove the existence of putrefaction.

The foregoing statement of the genesis and significance of indicanuria represents the present consensus of opinion on this subject. Various investigators of the condition have attempted to carry the significance of indicanuria a step further back in the etiological chain and to establish its causal relations to the conditions which de-

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termine and control intestinal putrefaction; these attempts have resulted in marked divergence of opinion.

Simon considers intestinal putrefaction and hence indicanuria as closely dependent upon the hydrochloric-acid content of the gastric juice, a normal amount of hydrochloric acid through its antiseptic action preventing putrefactive processes, while a deficiency of the acid will produce increased putrefaction and indicanuria. He regards the relation as being so close that the degree of acidity of the gastric juice may be directly judged by the elimination of the indican in the urine; nevertheless, he usually found indican present in gastric ulcer with its accompanying hyperacidity. He found indicanuria rare in simple constipation, and in diarrheal conditions due to colon lesions.

Musser and Pearce observed the occurrence of indicanuria in various disorders, especially septic conditions localized in the gastro-intestinal tract, e. g. in typhoid fever.

Gilbert and Weil from a study of two cases of diabetes conclude that hepatic insufficiency may lead to indicanuria, on the theory that the liver when acting normally may arrest the indican formed in the intestine, but that an incompetent liver permits its passage into the general circulation and thus the development of indicanuria.

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Wadsworth does not find indicanuria specifically associated with any definite disease, although he is tempted to observe "that nervous disorders depending upon malnutrition and those that influence nutrition markedly have a tendency to cause indicanuria."

Wells concludes as follows: "Indican is present in the urine in sufficient quantity to be detected during simple constipation, the amount varying somewhat according to the duration of the fecal stasis. Obstruction of the large intestine produces a much greater degree of indicanuria than the obstruction of the small bowel and causes in a few hours the most intense reaction, so intense as to be almost characteristic. Large quantities of pus produce a reaction which probably varies with the amount of absorption that is occurring. In carcinoma of the stomach there is usually a reaction when the disease is advanced; but probably not until motility is affected. But in these cases the indicanuria is produced by intestinal putrefaction, which is in turn caused by inability of the weakened general system to digest properly the proteid foods rather than to the cancer. Epilepsy and neurasthenia are accompanied by a varying degree of indican, and probably for reasons spoken of in connection with cancer."

Enriquez and Binet do not find that the condition of the gastric secretion has any

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influence on the formation of indican; nor that hepatic insufficiency produces indicanuria. They found indican increased in all cases of habitual constipation; and when found in diarrhea they regard this as resulting from fecal retention.

Jaffe states that indican is most increased in intestinal obstruction, and is also increased in diffuse but not circumscribed peritonitis, in which there is a considerable retardation of peristalsis; also in gastro-enteric catarrh, cholera Asiatica, typhoid fever, gastric carcinoma, and some blood diseases.

Porter draws some fine distinctions in the results of the tests for indican, and makes corresponding interpretations as to whether they indicate simple putrefaction or the association of other toxic conditions, and as to the state of the hepatic cells and the functional activity of the liver. He classifies the etiologic factors concerned in the causation of the indicanuria as chiefly excessive or improper diet.

From the foregoing representative articles it is seen that there is diversity and contradiction of opinion on some points involved; there does not appear to have been as yet any attempt to definitely place the blame for indicanuria, physiologically speaking, upon the organ or organs really causing it.

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A study of eighty-two cases of indicanuria which have been observed by me in my private practice during the past six months shows that no one condition or disease is common to all or to a majority of these cases.

The symptom-complex was, however, quite constant, each individual complaining of vague nervous sensations, such as slight continuous vertigo which was increased in dimly lighted places; dull headache; marked languor and drowsiness, especially during the periods of digestion; inability to concentrate the mind upon the work; a decided tendency to early fatigue with complete muscular relaxation; unusual mental irritability; vague pains in the lower limbs. These symptoms are usually ascribed to neurasthenia, but they disappear with cure of the toxemia.

The gastric analyses in these eighty-two cases gave the following findings: In thirty-nine there was marked hyperchlorhydria; in six hypochlorhydria; in thirteen achylia gastrica; the remainder showed normal gastric content. Of the eighty-two, twenty-eight had more or less decided gastric dilatation; while five showed varying degrees of ischochymia.

The blood in twenty-seven of these individuals showed well-marked anemia, which cleared up with the disappearance of the indican. This probably

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explains those chlorotic cases which resist all forms of internal medication, and which are promptly cured by colonic irrigations. Of the remaining fifty-five cases one was a case of pernicious anemia. The other fifty-four were normal.

This series of cases included four having ulcer of the stomach. Of these four, two had marked indicanuria all the time. One had no indicanuria until the middle of the fifth week of treatment at the time he was put back upon a more or less solid diet; the indicanuria lasted but four days and has never reappeared. The fourth case, one of large chronic ulcer at the pylorus, which came to operation and later to autopsy, showed the indican reaction only very rarely and even then but a slight trace, during the months he was under my observation; he also had marked pylorospasm with stagnation of the gastric contents. From my experience I judge that indicanuria in cases of gastric ulcer and hyperacidity is a complication rather than an essential consequence of the gastric disorder.

During this period we have had under observation five cases of cancer of the stomach in which the records of the urine are available, and in which the diagnosis was verified by the course and fatal termination. In three of these five cases the

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indican was normal throughout the periods of observation; in two others there was a moderate increase of indican.

In one case of cancer of the sigmoid, which came to operation, the indican was slightly increased now and then during the early months of the disease, but later it entirely and permanently disappeared.

Regarding the bowel-action in this series, forty-nine suffered from constipation; six had chronic diarrhea; eight were troubled with constipation alternating with diarrhea; the remainder had normal daily evacuations.

According to my observations indicanuria occurs in habitual constipation only when the general health has become impaired through neglect or from the pernicious cathartic drug habit by which the intestinal digestion is impaired. I believe it is invariably an expression of intestinal toxemia. That this intestinal toxemia can produce constipation through its inhibitory action upon the nervous system seems certain. It is equally true that when the organism is quite sensitive to the action of the poisons elaborated or when the amount of these toxins is increased beyond the point of tolerance, a sharp diarrhea occurs in the effort to eliminate rapidly the poison; and when the amount again falls below the point of tolerance a

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condition of constipation results. This readily accounts for many of those troublesome cases where constipation alternates with diarrhea over long periods of time.

From a study of the urine of patients suffering with catarrhal jaundice, cholelithiasis, cancer of the liver, and diabetes, I believe the occurrence of indicanuria with any affection of the liver to be a complication and not a direct result of the diseased liver.

That some cases of complete intestinal occlusion do not exhibit indicanuria is shown in a case of acute obstruction of the sigmoid which is just now under my observation. This woman has been constipated for thirty years, being compelled to take purgatives to secure every bowel action. For the past few weeks, under my direction, she had used enemata with good results. One day she stepped down from a high curbstone with a sudden jolt and experienced a severe pain referred to the hypogastrium. From that moment, for a period of six days, she did not pass either feces or flatus by rectum. At the operation there was found complete obstruction of the sigmoid due to traction of a tumor causing acute angulation. At no time immediately before the occurrence of the obstruction, during its continuance, or after the operation was there marked indicanuria.

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From the close study of these cases it seems certain that the seat of elaboration of the poisons giving rise to the indicanuria may at times be in the lower segment of the small gut, but that they are largely absorbed from the colon. I have come to this conclusion because I have found repeatedly that cathartics by mouth will, in ninety-eight per cent of all cases, either cause no change in the amount of indican or abruptly increase it; while in the remaining two per cent they lessen the amount or cause its disappearance only to recur shortly. Upon the other hand, when these ninety-eight per cent of cases are subjected to thorough high colonic irrigations with normal salt solution the indican in seventy per cent of the cases either abruptly disappears or is markedly reduced in amount; and if the irrigations are continued daily for a shorter or longer period, and at the same time the individual is limited as to the amounts of food taken, the cure is made permanent. Upon the other hand, if the individual is kept upon exactly the same diet and does not take colonic irrigations, while the amount of indican may and often does vary much from time to time, yet the condition with its pretty constant train of symptoms continues indefinitely. I have often noticed that, when a purgative has been taken during the course of a treatment as above outlined, there is a tem-

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porary reappearance or increase in the amount of indican which does not subside until the effects of the purgative have entirely passed off. This also to my mind is added evidence in favor of the opinion which I have expressed as to the seat of this natural laboratory and its distributing center.

The absorption activities of the various portions of the intestinal tract seem to have an important bearing on the genesis of indicanuria. In the colon, where indol is probably chiefly formed, absorption of it is considered to be poor under normal conditions and hence the largest part of the indol is passed with the feces and is not taken up by the blood; but when conditions are abnormal the indol which at times is formed during the disturbed conditions in the small gut, where it is not normally produced, is passed into the colon and if the absorption is pathologically increased it is readily taken up and gives rise to toxic effects and indicanuria.

The following deductions may be drawn from a close study of the 82 cases of indicanuria here analyzed:

*First.* The seat of formation of the toxins which give rise to indicanuria is in the lower segment of the small gut, as well as in the colon.

*Second.* The chief distributing center of the toxins is the colon.

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*Third.* The underlying cause producing the toxins is imperfect digestion of proteid foodstuffs in the small gut. Among the most frequent causes for this disturbed intestinal digestion are depressed nerve action due to overwork or disease; amounts, rather than quality, of food taken in excess of the ability of the intestines promptly to take proper care of it; too great preponderance of one class of food taken over too long a period, when at the same time there may be more or less nerve depression.

*Fourth.* The symptoms of indicanuria *per se* are not those of intestinal indigestion, with the exception of cases in which the degree of the putrefaction is so intense, or the mucosa is so highly sensitive, that toxins act as irritant poisons and cause diarrhea.

The symptoms are quite uniform and present a more or less constant symptom-complex of a nervous or cerebro-spinal type. The symptoms bear a direct relation to the degree of indicanuria. Upon the other hand indicanuria and its symptom-complex bear an inverse relation to the presence of symptoms of ordinary intestinal indigestion or of so-called "biliousness." Fever is not a symptom of indicanuria and when present is due to other causes.

The almost constant symptom-complex is as follows: The individual complains of malaise; a constant but slight headache; inability to concentrate his mind; an intense drowsy feeling but at the same time more or less troublesome insomnia; a constant more or less marked vertigo, which is greatly increased in dimly lighted corridors and rooms, so that he does not walk in a straight line from one point to another; impaired memory and great mental irritability.

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Fifth. The symptoms manifest themselves as soon as indican appears in excess in the urine, but persist for a greater or less time after the urine becomes normal, according to the duration of the indicanuria; for instance, a physician affected with indicanuria for a period of five days was entirely relieved of the symptoms within twenty-four hours after the disappearance of the excess of indican. On the other hand, in another patient who had suffered from this condition for eight years toxic symptoms continued for three or four months after the disappearance of the indican and then gradually subsided.

Sixth. Indicanuria in Washington is four times as prevalent from January first to June first as during the remaining months of the year, which fact goes to strengthen my assertion that the underlying cause for the disturbed intestinal digestion is nerve depression. For here where the year's work is crowded into a few months, brain fag begins in the early spring.

Seventh. The cure for indicanuria must come through preventing the formation of toxins and, what is quite as important, the elimination of the supply already on hand.

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## BIBLIOGRAPHY.

ENRIQUEZ AND BENET. Tribune Medicale, Par., 1907, XL. pp. 213-215.

GILBERT AND WEIL. Compt. rend. Soc. de Biol, Par., 1898, V, 346.

JAFFE. Deutsche Klinik, Berlin u. Wien, 1907, XI, 199-220.

MUSSER AND PEARCE. Maryland Med. Jour., Balto., 1894, XXXI, 277-281.

Digitized by Google

PORTER. Post graduate, Oct. 1907. Indicanuria; a Danger Signal. Its varieties and treatment.

SIMON. American Jour. Med. Sciences, Phila., 1894, CX, 48-157.

WADSWORTH. Proceed. Path. Soc. Phila., 1898-9. n. s. II, 116-121.

WELLS. West. Clin. Recorder, Chicago, 1899, I, 286-290.

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Extracted from the American Journal of the Medical Sciences, March, 1909

# INTESTINAL SAND: THE BANANA ONE OF ITS SOURCES.

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A careful perusal of the literature on intestinal sand brings one to a realization of the chaotic state of the entire subject at the present time: the symptomatology, the nomenclature, and the descriptions of intestinal sand are at present at great variance. Our attention was first directed especially to the subject by a case which we believed to be one of "true intestinal sand." Upon further study, however, we ascertained the real but extraneous origin of the sand, and at the same time we were led to the conclusion that the substance described in many of the cases owes its origin to the same or a similar source as that of our own. Contrary to the teaching of the French school especially, we do not consider intestinal sand a clinical entity nor productive of a definite train of symptoms. In arriving at these conclusions, we have endeavored to present as complete a bibliography as possible, and although some of the articles quoted may seem irrelevant, they have become so intimately interwoven with the literature in general that we deem it wise to record them here.

The sand in our case was of definite character, a finely divided material, and was passed by a young woman, aged twenty-four years, complaining of a feeling of intense fulness in the abdomen and chronic constipation. There was no gout or rheumatism in the family. The abdomen was tense and slightly tympanitic; there was a movable right kidney of the second degree; the stomach was in moderate ptosis, but otherwise negative. The feces were dark brown in color, firm in consistency, and contained a little mucus and fine granules resembling sand. One to one and one-half grams of this sand was washed from the feces daily. This sand was found in the motions for two weeks and then gradually disappeared. A nearer description of the substance will be given later.

We were at a loss to explain the phenomenon or to know in what relation the presence of the sand stood to the symptoms of which

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the patient complained. Nor did reference to the various text-books at hand tend much to enlighten us.

Emerson writes:[1] "True intestinal sand, of which we have seen but one good case, seems to be the result of a secretory neurosis of the intestine. It occurs in neurasthenic persons, and often in association with membranous colitis. Such stools are often preceded by about an hour of severe pain." Colmheim[2] and Thompson[3] state that the term intestinal sand or sable intestinal is applied to the passage in the stool of sand-like particles of varied composition, usually composed of masses of vegetable material, such as the granules from the pear, the seeds of raspberries, blackberries, etc. Osler[4] writes similarly, and adds: "I have recently seen a case in which the patient on two occasions passed a considerable quantity of sand. The sample which he brought consisted of small grains, some of a beautiful garnet color. They proved to be vegetable matter." Anders[5] and Sahli[6] speak in this connection of hepatic calculi which have passed into the intestine, or earthy concretions or incrustations of food rests with earthy salts. Schmidt and Strasburger:[7] "The small concretions, which by the French authors go under the name of intestinal lithiasis, are often associated with membranous enteritis." Nothnagel[8] differentiates between the true and the false extraneous intestinal sand. He says that true intestinal lithiasis is nearly always associated with mucous colic. It has been regarded as due to a lithogenic catarrh of the bowel, and might be compared with the process which gives rise to the formation of concretions in the vermiform appendix. False intestinal sand may be of various kinds, but is usually the remains of indigestible vegetable food, which may or may not become encrusted with earthy salts.

The vague and meagre text-book references are out of proportion to the voluminous clinical reports on the subject, in which all manner of symptoms are cited and attributed to the presence of the sand. We shall cite here briefly a few of these reports in order to show that the present acceptation of the subject is based largely upon a popular fallacy which has been handed down from one author to another.

To Laboulbene[9] is justly given the credit of reporting the first cases of intestinal sand in 1873, under the title, "Les sable intestinaux." He reported cases in which he found a sandy substance (sable intestinal) resembling very much brown or yellow sand, which he believed to be of vegetable origin.

[1] Clinical Diagnosis. 1906, p. 371.
[2] Die Krankheiten des Verdauungskanals, Berlin, 1905, p. 169.
[3] Text-book of Practical Medicine, 1902, p. 434.
[4] Practice of Medicine.
[5] Ibid., 1905.
[6] Klin. Untersuchungsmethoden, 1905, p. 455.
[7] Faeces des Menschen, 1903, p. 227.
[8] Encyclopedia of Practical Medicine, Intestines and Peritoneum, Amer. Edition, 1904, pp. 94 to 96.
[9] Bull. de l'acad. de méd., November, 1873.

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The next article to which we find reference is that of Biaggi.[10] Strictly speaking, this case bears no relation to that described by us, and we should not consider it worthy of mention in this connection were it not for the fact that the author considered the calculi a manifestation of a true diathesis, which hypothesis seems to have formed the foundation for subsequent articles of French authors, in which this belief is prevalent. Marquez,[11] in 1879, reported a case of a woman with herpes, an arthritic disturbance, chronic catarrh of the large intestine, more or less pain, especial intolerance for vegetables and fruits, etc. In this case sand was discovered in the feces, which had the aspect of corpuscles, mostly granular, brown or some white. The sand was of irregular form, and some grains bristled with small crystals. Into their composition entered nitrogenous matter and to a marked degree mineral matter, containing 72 per cent. of organic matter and 28 per cent. of inorganic matter, mostly the carbonate and phosphate of calcium. The subject seems to have received no further consideration in the literature until 1895, when Monjour[12] describes the case of a young woman, "arthritic and neuropathic," with a mucomembranous colitis, obstinate constipation, and the presence in her stools of small gravel.

Fontey[13] presented a Bordeaux Thesis upon this subject. He states that under pathological conditions the intestinal mucosa may give rise to sand, and quotes the articles of Schoenlein[14] and Bellingham[15] in proof thereof. The former, in an epidemic of typhoid fever in 1835, found in the stools microscopic crystals of calcium phosphate and sulphate and a sodium salt, which he thought were constantly present in typhoid fever and of decided diagnostic value. The latter's case was one of bronchopneumonia, in which the postmortem examination showed great numbers of ammonium magnesium phosphate crystals in the colon. Oddo,[16] in 1896, reported the case of a woman, aged fifty years, with rheumatism, frequent attacks of urticaria, arrhythmic pulse, emotional spells of fainting, and painful intestinal crises. The stools were found to contain bodies of irregular shape, varying in size from a grain of sand to a small lentil. Mathieu and Richard[17] reported two cases in which the patient passed quantities of fine sand, of a dirty yellow or chestnut-brown color, in diameter from 0.25 to 1.5 mm. The authors express surprise at the frequency with which mucous enteritis existed in cases of intestinal sand which have come under their notice. Shattock,[18] in 1897, gives an excellent description of a case

[10] Presse méd. Belge, v. 26 (20), 19 avril, pp. 153 to 154.
[11] Assoc. Française pour l'avancement des sciences, 1879, p. 878.
[12] Compt. rend. de. la soc. biol., series 1, 1896, t. iii, 203.
[13] Thèse de Bordeaux, 1896.
[14] Arch. f. Anat., Phys. u. wissensch. Med., Berlin, 1836, pp. 258 to 261.
[15] Dublin Jour. Med. Sci., 1838, xiv, 278.
[16] Bull. et mém. de la soc. méd. des hôp., June 25, 1896.
[17] Ibid., 473.
[18] Trans. Path. Soc., London, xlviii, 124.

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of intestinal sand under the title of "sable intestinal." The material consisted of small spheroidal grains of a pale brown color, which he thought were composed of compact groups of thickened vegetable cells, having the character of sclerenchyma extremely thickened by a succession of secondary deposits. The patient had suffered from hydronephrosis, and these cells were first mistaken for urinary calculi.

Dieulafoy[19] has presented one of the most exhaustive treatises on the subject, in which he recites a large number of cases. He lays the greatest stress upon the frequency of mucomembranous colitis, and believes intestinal sand to be a manifestation of a lithogenic diathesis, and therefore comparable with the kidney stone and tophus. The following is an abstract of one of his cases: A man, aged forty-eight years, gouty father. He himself gouty. Headaches, hemorrhoids, eczema, asthma, renal colic, with phosphatic calculi. Several years later a new phase developed. In the evenings the patient had pain in the right hypochondrium, spreading to the epigastrium and thorax. In his stools he found intestinal sand and mucus. It is important to note that on the day the intestinal sand made its appearance the pain about the kidney ceased completely. The author considers that these observations show the relation that exists between intestinal lithiasis and gouty diathesis, though he does not maintain that all cases are of a gouty nature. One can see that renal and biliary lithiasis are seen in the same individual at different times of life, or exist in the family as an hereditary manifestation.

Eichhorst[20] takes exception to the fact that the term "sand" is used indiscriminately for fine sand-like bodies, as well as for the large concretions. He thinks that intestinal sand is not a frequent occurrence, having seen only two cases in seventeen years. His first was in a woman, aged thirty-five years, who complained of obstinate constipation, which had not yielded to treatment. The grains were in every way like a sand when shaken up in a test-tube or placed under the microscope. In water the granules remained unchanged after days; also in alcohol and ether. The grains contained earthy carbonate salts, which upon the addition of mineral acids were seen to generate gas. As to the organic portion, two kinds were differentiated: one was composed of thread-like masses, which were held together by a transparent mass, the other was in all probability crystals of fatty acid. The next year Deetz[21] reported a case in a man, aged fifty years, who had symptoms characteristic of renal colic, and noticed sand-like bodies in his stool. The sand was hard, finely granular, and had a light or dark brown color. Saint-Phillippee,[22] in discussing the occurrence of crises of abdominal pain in children associated with constipation, states that in 50 such cases he has also found an intestinal lithiasis.

[19] Bull. de l'acad. de méd., Paris, 1897.
[20] Deut. Archiv f. klin. Med., lxviii, Heft 1 and 2.
[21] Ibid., 1901, lxx, 365.
[22] Jour. de méd. de Bordeaux, 1901, No. 49.

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In the English literature, the authors have, as a rule, described fine sand-like substances, and not gravel or larger concretions. Bedford[23] gives the following description: "The sand was a very fine, granular, yellowish brown substance, very like fine sand, of which not more than one-half teaspoonful was passed at a time. Under the microscope the particles were of various shapes and sizes, oblong, oval, or irregular. The color varied from black, through reddish brown, to light yellow. Many of the granules were translucent only at the edges, and had no appearance of vegetable or crystalline structure. The organic portion amounted to 60 per cent." The same year Duckworth and Garrod[24] reported a case in a woman, aged thirty-three years, who had an attack of persistent diarrhœa lasting for three or four months. The stools contained oblong, rod-shaped, or irregular granules, 0.05 to 0.2 mm. long, varying in color from yellow to brown, some translucent, others opaque, except at the edges. The organic portion amounted to 40 per cent. Mitchell[25] reports a case of a man, aged forty-two years, who passed a pale brownish sand while on an exclusive milk diet. Ferguson and Thompson[26] have reported the case of a lady, aged thirty years, with moderate dilatation of the stomach, and at times decided neuroses approaching hysteria. In one of her periodical gastric attacks, she was given milk and lime water, and during this time a considerable amount of sandy matter was discovered in the motions. The sand was passed regularly for several months. It sank rapidly in water, presented a brownish yellow appearance, strongly suggestive of uric acid, and when examined microscopically the resemblance was striking. However, the murexide test was negative. Tierlinck[27] recently reported a case occurring in a woman, aged thiry-eight years, who had very painful abdominal crises, localized along the colon. The stools revealed the macroscopic presence of intestinal concretions of greater or less amount with much mucus.

When we survey the various descriptions of the intestinal sand in the articles we have just reviewed, it seems that we may separate them roughly into three classes: (1) Those in which the material really resembled fine sand-like granules, ranging in size from 0.15 mm. up to 1 or even 2 mm.; (2) those in which the word gravel or calculus more nearly suits the description than the word sand, the objects varying from the size of a lentil to that of a pigeon's egg or larger; and (3) those in which the description of the material itself is so indefinite that we can only infer that in using the term intestinal sand, the author had before him some sort of intestinal concretion resembling those of either class 1 or 2. We shall, therefore, confine ourselves to a consideration of these first two classes. When we examine those cases in which the "sand" is large as orange seeds,

[23] Lancet, 1902, ii, 215.
[24] Lancet, March 8, 1902; Medico-Chir. Trans. 1901, lxxxiv, 389.
[25] Trans. Coll. Phys. Phila., 1903, xxv. [26] Jour. Path. and Bact., 1900, vi, 334.
[27] Bull. soc. de méd. de Gand., 1907, lxxiv, 96, 97.

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the question at once arises, Are these not ordinary fecal concretions? Biaggi describes balls 6 to 8 cm. in circumference, composed of ammonium magnesium phosphate, plant hairs, cells, etc. Oddo describes bodies varying in size from a grain of sand to a lentil, with 28 per cent. fatty material. Most certainly this seems to be nothing else but inspissated fecal matter. In fact, Dieulafoy, in one of his cases, gives the following analysis of the concretions: Water, 11.25; fecal matter, 22.60; phosphoric acid, 17.56; calcium 26.22; magnesium, 14.05; silica, 5.68. It is true that this shows a somewhat greater proportion of inorganic salts than we would expect in ordinary fecal material, unless the patient had taken considerable milk.

When we turn to look at those cases coming under the first class, small sand-like grains, we are confronted with a puzzling variety of materials of various description: grains 0.2 to 1 mm., with irregular crystalline projections, accompanied by unaltered vegetable cells thickened by secondary deposit, which measured from 0.5 to 1 mm., and had been diagnosticated as renal calculi (Shattock). In the first case of Eichhorst the sand was "like urinary sediment." Duckworth and Garrod describe grains 0.05 to 0.2 mm., containing 60 per cent. ash, some of which was carbonate. These authors also distinguish between "false" and "true" sand, that which contains a nucleus of vegetable cells, or fruit seeds, such as Delepine and Verco have described, and that which (supposedly) has no such origin and is mostly composed of inorganic salts. Bedford also makes the distinction between "true" and "false" sand, and says that true sand contains a much higher percentage (28 to 70 per cent.) of inorganic salts than the false variety, except "in the case of the calculi produced in the intestines of people fed upon bread made from oat bran, which often contains from 60 to 70 per cent. inorganic matter." It seems more reasonable to believe that when the sand contains a large amount of mineral salts the cell or cells which had formed the nucleus are overlooked, and the sand is "true" sand; when the deposit has not been so great, the vegetable structures may be seen, and it is then considered "false" sand. Granted, perhaps, that there were such a thing as true sand, formed by an excretory process of the intestinal mucosa, we would still be at a loss to explain the 30 to 70 per cent. of organic matter which this true variety contains, for the ordinary organic constituents of the body, calculi, urea, cholesterin, uric acid, etc., are all absent. Delepine,[28] who has described specimens of "sable intestinal" which were formed by cells from the pear and various seeds coated with salts, calcium carbonate, phosphates, and oxalates, says, "It is only when these seeds are retained some time in the bowel and have time to become covered with calcareous matter that their presence is of interest to

[28] Trans. Path. Soc. London, 1890, xli, 111.

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pathology." This statement becomes more significant when we notice that in the cases of Mathieu and Richard, Eichhorst, Ferguson, and Bedford, who give a high inorganic content for the sand, the patients suffered from "habitual constipation." Verco[29] found in the stools of one of his patients small sand-like particles which he found later were the cells of the pear with calcareous coating, which consisted of carbonates and phosphates.

As to the various clinical manifestations which have been mentioned in relation to intestinal sand, we believe them to be largely unrelated and accidental, except as to the role constipation may play. However, it does not seem at all strange that gastro-intestinal symptoms have been encountered in practically every case reported. Physicians in general do not make a habit of examining the feces of every patient irrespective of intestinal symptoms, and it is only when such symptoms exist that they feel it necessary to note the character of the stool. The immense number of times that intestinal sand is present without some concomitant gastro-intestinal trouble is not taken into account. As to the importance of mucous colitis as an etiological factor, since this is the disease par excellence in which an examination of the stool is always made, in which the diagnosis is directly dependent upon such an examination, we need not be surprised that intestinal sand has been found in some of these cases. That it is not present in a majority, or even in many cases, does not need to be proved. We shall not deal with the great variety of other factors which have been brought forward as having an etiological bearing upon the subject. However, to show to what extreme this speculation has gone, we might cite the remarks of McNamara[30] and Renshaw,[31] who suggest that the excretion of sand is a reversion in the mammal to the egg-shell-forming function of the bird, and Bernhang,[32] who thinks that just as discharges of meconium in certain presentation of the fœtus subpartu is to be viewed as a signum mali omnis, so would he consider discharges of intestinal sand as a sign of the patient's being in greatest danger of life.

We wish now to go somewhat more definitely into a description of the sand in our case, its origin, and possible relation to the cases already cited: Upon macroscopical examination the stool was seen to be full of small black or brown sand-like granules, intimately admixed. The stool was washed through a fine sieve, and both the wash water and the residue were carefully examined. The greater amount of sand was to be found in the wash water, a dram or two being obtained from each washing. It has a brownish, sandy appearance, and feels gritty when taken between the fingers. Under the microscope the sand is seen to consist of irregularly shaped grains, varying in size from 0.05 to 0.2 mm., approximating

[29] Australasian Med. Gaz., Sydney, 1904, xxiii, p. 300.
[30] Brit. Med. Jour., 1903, i, 311.
[31] Ibid., p. 666.
[32] Deut. klin.-therap. Woch., 1906, iii, 428

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more or less the oval form (Fig. 1.) They are translucent, but not transparent, and vary in color from a light yellow to dark yellow, brownish and greenish yellow, and many of them are of the color of uric acid crystals or garnets. When viewed by reflected light, the grains have a beautiful appearance, resembling a collection of varied colored quartz. The grains are hard and brittle and are crushed with great difficulty under the cover glass. In one specimen which we obtained, concentrated acid caused the evolution of gas, and the sand became a much lighter yellow. Boiling water, alcohol, ether, chloroform, and dilute acids had apparently no effect upon the granules. The murexide and sodium hypobromite tests were negative.

FIG. 1.—Intestinal sand obtained from the feces twenty-four to forty-eight hours after the ingestion of a banana.

We are indebted to Dr. Wm. H. Warren, of Washington University, for the examination of a single specimen of sand, in which he found 17.2 per cent. of moisture, after the extraction of which there remained 95.8 per cent. of organic matter. The nitrogen determination (Kjeldahl) yielded 2.5 per cent. The inorganic portion was found to consist mainly of phosphate of calcium.

We had arrived at the conclusion in our own minds that this sand was of vegetable origin, because of the high organic content, the regularity of shape and size of the grains, etc., but were laboring under the false impression that they were cellulose remnants, which through a prolonged sojourn in the intestine became permeated with certain insoluble salts, whose origin we were unable to explain. We felt the more certain of this upon finding in a single specimen of feces from a child several chains of sand, identical in appearance with the grains found in our first case. We endeavored, through the ingestion of various vegetables, to produce sand artificially, but were not able to do so. While making a routine examination of a specimen of feces, our colleague, Dr. Wm. Rush, called our atten-

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tion to a chain of sand, together with two or three fibrovascular bundles having their origin from a common point and separated by a mass of parenchyma cells. It was suggested by him from its histological structure that this might be a remnant of the tissue of banana, and this it proved to be. Following this suggestion, we were able to produce, ad libitum, sand identical with that found in our original case and apparently identical with that described by various authors, and to which a long train of symptoms were attributed. Through eating one or two bananas and examining the feces twenty-four hours later, intestinal sand may be found in teaspoonful to tablespoonful quantities, and may be found for several days afterward, diminishing gradually. In case of constipation, it may be found for a much longer period. The grains are found singly, as a rule, but also in chains if the stool is not manipulated too much in the process of washing. The discovery of the banana as a cause of intestinal sand enabled us to examine the literature from another standpoint, whereupon we met with the

FIG. 2.—Transverse section through the ripe banana treated with a 10 per cent. aqueous solution of ferric chloride, showing the pansy-like arrangement of the milk tubes.

following references: Bates,[33] in 1887, published a paper entitled "Intestinal Concretions Resembling Sand and Originating in Cells from the Banana," in which he described these same small, organic, sand-like cells which he had washed from the stools of a child suffering from habitual constipation and attacks of gastric colic. He had shown these cells to a great number of physicians, without being enlightened as to their origin, when Edes[34] recognized them as of the same origin as those he had described. Edes was also led to the proper interpretation of the banana as the origin of the sand, by the fact that some of the undigested banana tissue accompanied the sand-like cells.

If the banana is sectioned transversely and exposed to the air for a time, light brown markings appear on its surface, radiating from the centre toward the periphery, where they turn to form an arch with an adjacent line. If certain substances are poured upon its surface, such as ferric chloride, which acts very rapidly and decidedly,

[33] AMER. JOUR. MED. SCI., 1887.
[34] Boston Med. and Surg. Jour., May 10, 1883.

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these markings are beautifully brought forth (Fig. 2). They stand out as black chains or strands embedded in the tissue of the banana. Under the microscope these are found to be identical with the grains and chains of sand found in the feces of those ingesting bananas, but are not so hard. If one obtains a thin section of the banana, or strips off one of the long longitudinal strands from the inner side of the peeling, and treats this with ferric chloride, the chains are found to be made up of small masses of a garnet-colored substance, each contained within a cell membrane. The garnet-colored bodies are evidently the contents of the cells (Fig. 3). If examined in a fresh state, unaffected by chemical agents, these cells are found to be chains or threads of homogeneous bodies united end to end, soft enough to be influenced by pressure upon the cover glass,

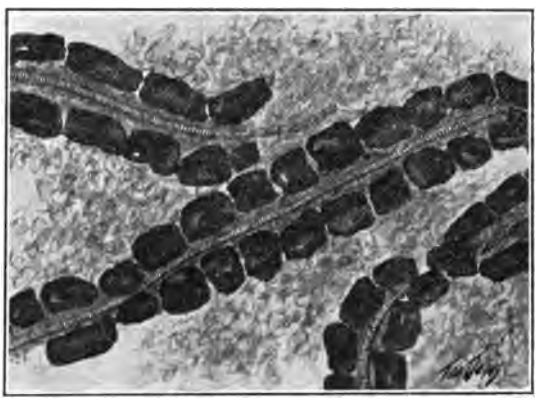

FIG. 3.—A small portion of a banana treated with a 10 per cent. aqueous solution of ferric chloride (magnified 70 diameters), showing double chains of milk-tube cells accompanying the fibrovascular bundles, with parenchyma cells intervening.

which causes them to burst and exude a gelatinous, colorless mass. The chains run in pairs, surrounding the fibrovascular bundles. In the botanical literature, put at our disposal by Professor W. Trelease, of the Missouri Botanical Garden, were found but few references bearing directly upon the subject. In Engler and Prantl[35] reference is found to the milk tubes in the Musa, which consist of cylindrical rows, one above the other, of cells rich in tannin. De Bary[36] refers to jointed milk tubes (gegliederte Milchröhren) produced by end to end fusion of cells, and says: "In the stem, as well as in the fruit, the vascular bundles are accompanied by milk tubes two to six in number, symetrically arranged and separated from them by one or two layers of parenchyma cells. . . . These milk tubes consist of a row of vertical cylindrical cells, one above the other, four times as long as they are wide, and through a round

[35] Die Natürlichen Pflanzenfamilien, 1889, ii, 6.
[36] Vergleichende Anatomie bei Phanerogamen und Farne, 1877, pp. 153, 160, 451.

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wide opening at each end are converted into a continuous tube. They contain large homogeneous, highly refractive resin balls or masses, suspended in a fluid very rich in tannin."

These resin balls, then, the contents of the cells, suspended in a fluid rich in tannin, are affected by the secretions of the stomach and intestine in a manner similar to the action of the ferric chloride, hardening the resin and producing an insoluble tannate. The cell wall is digested or destroyed, and the hard resin-tannin-containing mass is liberated as a grain of sand. The extreme hardness of the grains found in the feces is due evidently to the prolonged influence of the secretions and salts in the intestinal canal, and the color to a tannate formed, influenced perhaps to some extent by other coloring matters in the intestines. We were unable to give the same hardness to the sand produced artificially outside of the body through treating it with hydrochloric acid and pepsin, saliva, pancreatin, ferric chloride, or by mixing it with the feces, etc., though nearly all of these agents hardened the grains to a certain degree and gave to them the typical color. Thus far, we have been unable to find other fruits or vegetables which give rise to similar bodies.

That intestinal sand may be produced through the ingestion of the banana has been proved by us beyond a doubt; that the descriptions of the sand reported in the literature by some authors seem identical with ours is certain; that many of these were due to the ingestion of the banana, or some other fruit or vegetable having like structure, seems most probable.

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## DISCUSSION.

Dr. Jesse S. Myer, St. Louis: I agree fully with the essayist in the statement that milk is not the ideal food for ulcer patients in the early treatment of the condition. I have tried it faithfully in all stages of peptic ulcer; the patients have found it unpalatable. In its pure state it is apt to produce large curds that mechanically irritate the ulcer.

I do not favor the use of albumin water, because it also seems an irritant to the ulcer. I have gotten my best results during the first week with the use of some form of soluble carbohydrates, and of late I have been using meals prepared abroad. They are made of oatmeal, peas, lentils or barley. These are partially dextrinized, and evidently form no solid mass in the stomach. This flour shows the finest possible division. It is first given in a perfectly liquid state, about the same consistency as milk, and then the quantity of flour added to it is gradually increased. I have also used broths, making a *schleimsuppe,* so highly recommended by the Germans, especially those made of lentils and peas. Later on, one may add a little milk, and then gradually bring the patient up to the use of milk in the second week, and in the course of time add other foodstuffs.

Dr. J. C. Johnson, Atlanta: I have recently found that in some of these cases where the milk is apparently badly borne the objections to its use may be overcome by using one-third lime water and two-thirds milk, to which I have added half a teaspoonful of bismuth and bicarbonate of soda. In one case where rectal feeding was very unsatisfactory I finally depended entirely on milk. This produced a troublesome constipation, and I added a little calcined magnesia to keep the bowels open. Recently, I have prescribed the other mixture in a number of cases with very good results, and I have frequently found it stopped the nausea and vomiting complained of by these patients.

Dr. Gustave Fütterer, Chicago: The method of treat ment I use in these cases is based on clinical experience and experimental work. The results of my experimental work, written in German, forms a part of the *Festschrift* to Professor Rindfleisch, and was published under the title *Uber experimentalle Erzeugung von Magengeschwüren, und über Schleimhautwucherungen an deren Rändern.*

In the first place, we know that ulcer patients are anemic, and that they become more so after hemorrhage. This must be well considered. In my experimental work I resected pieces of mucous membrane of the stomach of healthy dogs, and subsequently found that these artificial defects had healed so well that I could not even find a trace of them. I then preceded the operation by removing one-third of the animal's blood, and found that the stomach

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defects again healed promptly. I then removed as much blood as possible without killing the animal, and found that this profound anemia prolonged the healing of the artificial defect. Upon killing the animals two weeks after the original experiment I found defects which resembled ulcer so much that they could easily be demonstrated as ulcers, but the edges were round instead of sharp, and the bases were covered with granulations. Then I gave the animal injections of pyrogallic acid to destroy the hemaglobin, and if I did that sufficiently well, I got typical ulcers which refused to heal. These defects then not only had the characteristic appearance of an ordinary gastric ulcer, but they also possessed its clinical peculiarities, and they showed no tendency to heal as long as the anemia persisted. They perforated and caused hemorrhages, just as in human beings, and later they proliferated at the edges, as we see them in carcinoma developing in man.

After such experiences, one cannot but be impressed with the idea that anemia plays a prominent part in gastric ulcer, and naturally, in the treatment of these cases, I considered it of the utmost importance to at once attempt to bring up the hemaglobin, because if we do not do that, we prolong the healing of the ulcer, we prolong the period of the danger of hemorrhage and perforation, and later on of carcinoma. In order to enrich the quality of the blood I immediately give the patient beef, prepared in the proper manner. In my experience with gastric ulcer, I have seen no hemorrhages and no perforation since 1896. In not a single instance was there any bleeding after the patient had been in bed for a day or so.

Among the later sequelae of gastric ulcer, we should not lose sight of the possibility of carcinoma. It is a rule that carcinoma of the stomach develops from old ulcers, and I have seen one develop from an ulcer the size of a silver dime.

In the treatment of patients suffering from gastric ulcer, I do not resort to rectal feeding because it is unsatisfactory even under the most favorable conditions. Besides, there are other objections to the procedure; although I have never read in medical literature of accidents occuring after feeding per rectum, I have seen quite a number of serious accidents result, especially the production of vomiting. This is sometimes prolonged, and in one instance I have seen it followed by deep collapse. A safe rule to follow is that if a cleansing enema seriously disturbs the patient, stop it.

Dr. Fenton B. Turck, Chicago: Dr. Bell's paper is limited to the management of gastric ulcer, and I do not see how we can discuss it without some clearly defined idea of the character of the lesion and its etiology. The essayist brought out some few points that are well known

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regarding the management of gastric ulcer, and which are based on purely empirical grounds. Until we know absolutely what constitutes gastric ulcer, we shall have to continue our treatment along these empirical lines. Many conflicting statements have been made in regard to the proper method of treatment, but after a time these views will be brought into harmony.

The experimental work referred to by Dr. Fütterer is epoch-making in its importance, and brings out the idea of a general systemic condition as an important factor in at least the persistence of gastric ulcer. The work that I have done along these lines was undertaken with the idea of producing a general systemic disturbance by feeding the animal with the bacillus coli communis taken from the feces of a patient who was suffreing from well-recognized gastric ulcer. I was enabled, through certain surgeons in this city, to see these well-defined ulcer cases and obtain from them the cultures from the feces. The report of these experiments are already on record. In brief we found that the production of these ulcers in animals was spontaneous, that the ulcers were well-defined in character, and, similar to those in the human being, they were apt to result in perforation and death. There was more or less harmony between the results of my experiments and those reported by Dr. Fütterer.

There may be some difference in our method of treating gastric ulcer, but these methods will become harmonized when the indications are better understood. Lenhartz's method of treatment was not referred to extensively in the paper, but we all remember his great work, and the use of meat in these cases, as recommended by him, has been of unqualified benefit. Meat is especially indicated in these cases because it is quickly digested, particularly when it is first treated by hydrolization. If we take the ground meat press out the juice and discard it, and put the residue in an autoclave for several hours, we have its connective tissue elements turned into gelatin, and the stearin as well as the extractives removed. By this method, the meat, which before contained only 20% of protein, now contains over 50% of protein. This product immediately takes up free hydrochloric acid, and is less irritating to the stomach; it is more digestible than casein or eggs, and passes rapidly out of the stomach.

All cases of gastric ulcer, of course, must not be treated in this way. Each method of treatment has its place, but this is the chief suggestion I have to offer, and I have used it in many cases to great advantage. Stimulation of the patient should not be overlooked, thereby increasing his general resistance, and the number of anti-bodies in the blood.

When we come to the question of operation for gastric ulcer, I would like to call attention to the fact that Moy-

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nihan, in his recent writings, discourages the idea of operating in the face of hemorrhage. We have just heard from Dr. Fütterer that he does not have hemorrhages by his method of treatment, and Moynihan, who is a radical operator, objects to operation after hemorrhage. He objects to such a line of treatment. A number of years ago I called Dr. Fütterer in to see a woman who had had a severe gastric hemorrhage, leaving her with a color as pale as the white wall. The question of operation came up, and when I broached the idea, Dr. Fütterer shook his head. I have seen many of these cases since, and I have become more and more convinced of the inadvisability of operating in the face of severe gastric bleeding.

When we have an ulcer of the pyloric end of the stomach, Moynihan is of the opinion that a gastroenterostomy is useless. I saw several cases in Müller's clinic where jejunal ulcers followed gastroenterostomy, and these the operator said he could not cure. Mayo recently advocated Rodman's method of resection in all these cases. All surgeons agree that whenever an operation is demanded, it should be combined with a long course of medical treatment. We are dealing here not only with a local conditon, but with a general systemic condition which requires general treatment.

Dr. Franklin W. White, Boston: I agree entirely with Dr. Turck in regard to the question of hemorrhage and operation. In Boston we do not advise any more surgical interference in acute gastric ulcer with dangerous hemorrhage, first, because the surgeons have found it difficult or impossible to locate the ulcer within a reasonable length of time; second, because almost every operation of this kind has thus far proved fatal. I do not think that this is the fault of our surgeons.

The question of the general nutrition of the patient on the healing of a gastric ulcer is very important. Any ulcer heals better if the patient is not starved. Dr. Edsall of Philadelphia has recently shown us the physiological limit of rectal feeding. It should really be looked upon as a partial starvation, with the number of calories limited to five or six hundred. Of late years I have followed Lenhartz's teaching who begins at once by giving some very bland and unirritating food by the mouth; something that will combine well with the acid, such as milk, egg, sugar, etc., and gradually increasing the amount. This method can be combined, if necessary, with rectal feeding, but we should not depend upon the latter alone.

Dr. J. C. Johnson, Atlanta: I would like to ask Dr. Turck or Dr. White what they mean by acute gastric ulcer?

Dr. Franklin W. White, Boston: In reply to Dr Johnson I would say that by the term acute ulcer with hemorrhage I would mean a case in which the bleeding is so profuse as to threaten life. Under those conditions, medical treatment is preferable to surgical treatment.

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## DISCUSSION.

Dr. Henry Wald Bettmann, Cincinnati: The paper we have just listened to is a very excellent illustration of clinical observation and laboratory research, and it embodies as well a careful review of the literature on the subject.

About ten years ago, at a meeting in Cincinnati, specimens of intestinal sand similar to the artificial ones shown by Dr. Myer, were exhibited. They were sent on to Washington for examination, and were traced, as in this case, to the banana. So far as I am aware, no publication of the matter was made.

Dr. John A. Lichty, Pittsburgh: The paper of Drs. Myer and Cook will mark the Chicago meeting as one of the important meetings we have had in the last few years. It has certainly opened up and explained a subject which has been a source of considerable worry and trouble to many physicians.

I remember a few years ago one of our physicians in Pittsburg found this intestinal sand in the stools of a child, and he sent it to various laboratories, without receiving any definite information as to its source. The presence of the sand in the stools was regarded as the cause of the intestinal disturbances from which the child suffered, and finally, specialists from New York were called in. The sand was repeatedly found in the stools, both with and without the presence of mucus.

I have noticed that patients who suffer from mucous colitis are apt to pay close attention to their stools, and some of these have reported the presence of sand. I have also found it in the stools of children who had nervous mothers, but hereafter, instead of attributing its presence to the nervous mother, I shall be on the lookout for the banana.

Dr. Franklin W. White, Boston: The only case of this kind that I can recall was one in which the stools were examined in the Clinical Laboratory of the Harvard University, and were found to contain some bodies which we took to be parasitic eggs, but which later proved to be of vegetable origin. Probably there are other vegetables than the banana that produce sand in the stools—perhaps of a different character.

Dr. John P. Sawyer, Cleveland: I would like to ask Dr. Myer if he made any experiments with cooked bananas, and if so, whether the sand was also present in those instances?

Dr. Jesse S. Myer, St. Louis: (Closing the discussion). No, we have thus far made no experiments with the cooked banana. There were a number of things that I had hoped to do with reference to the presence of objects of this kind in the intestinal tract, with the idea of ascertaining what influence it had on constipation. Reasoning along

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the lines that food substances containing a considerable residue relieves constipation, the same should occur here, but thus far I have not carried out these investigations.

In answer to the question by Dr. White I would say that when one knows of the presence of these grains, it is not difficult to see them with the naked eye, but they readily escape observation unless carefully looked for. They appear as small black granules. One of the specimens now being passed around contains a great many triple phosphate crystals.

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[Reprinted from the Boston Medical and Surgical Journal, Vol. cliv, No. 9, pp. 265-267, Aug. 27, 1908.]

# GASTROMYXORRHEA.*

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THE presence of small quantities of mucus appearing occasionally in the fasting stomach has been noted by a few observers, as Ewald,[1] Riegel,[2] but credit is due Dauber,[3] who first pointed out the clinical significance of this condition, reporting a case of Leube's in full, and naming the disease chronic hypersecretion of mucus or gastrosuccorrhea mucosa. In a further investigation Kuttner[4] determined that this condition was not infrequent and may often be observed in certain patients if lavage be practiced on an empty stomach. Both Schmidt[5] and Tellering[6] have pointed out that a small quantity of mucus is usually observed in the fasting stomach, amounting to from 2 to 5 ccm. It is necessary, therefore, to place a limit upon the quantity to be considered normal and any amount beyond this must be regarded as pathological. Kuttner considers the existence of more than 5 ccm. of mucus in the fasting stomach as abnormal and when over 25 ccm. in amount as indicative of the condition which he terms gastromyxorrhea. In order, however, to prove the existence of this condition it is necessary to consider the method by means of which the mucus is obtained. The mucus must be constantly present or reappear at certain intervals. The patient must be accustomed to

* Read by title at the annual meeting of the American Gastro-Enterological Association, Chicago, June, 1908.



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the use of the stomach tube; and the moving of the stomach tube to and fro as well as the prolonged use of the tube in the examination inducing the secretion of mucus must be avoided; on the other hand, repeated examinations must be made in order to arrive at a definite conclusion regarding the abnormal secretion of mucus. Kuttner concludes that in a certain series of cases there exists a condition in which a large amount of mucus is secreted, either permanently or intermittently in the fasting stomach.

This secretion has the following properties in uncomplicated cases of gastromyxorrhea:

1. It is grayish white, milky, slimy and stringy. It contains translucent swollen lumps of fine specks of mucus and is without special odor. Pouring from one glass to another the contents are markedly stringy, and on standing in a conical glass separate into two layers: a turbid fluid, the chief part, and a small layer at the bottom consisting of a whitish sediment enveloping finer and larger lumps and specks with masses of mucus. These particles come from the bronchial, pharyngeal and esophageal mucous membrane, and are pigmented or even mixed with pus. Sometimes masses of mucus of translucent, foamy or purulent nature coming from the mouth or pharynx float on the surface of the liquid. In some cases the mucus from the fasting stomach is colored yellowish or greenish yellow, due to a mixture with bile or intestinal secretion. In uncomplicated cases food remnants are never present.

2. The secretion in typical cases of excessive mucous secretion appears feebly acid, neutral or often alkaline. The value of total acidity varies between 6 and 8; free and combined HCl could never be detected nor was lactic acid even present.



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3. The pepsin varied as determined by the method of Mett between 2 and 4 mm. and occasionally the ferment was completely absent; at times markedly diminished.

4. The test for sulpho-cyanates was negative and Trommer's test was also negative. On the other hand the biuret test gave a positive reaction. Gmelin's reaction was sometimes positive, but more frequently negative.

5. When grape sugar was added to the secretion and the mixture placed in the incubator at 37° C. no formation of gas appeared, even after standing several days.

6. The examinations for blood were generally negative, but occasionally positive.

7. The specific gravity of the mixture varied between 1,003 and 1,010.

8. Determination of the freezing point gave values between 0.29° and 0.44°.

9. The microscopical examination of the secretion obtained from the fasting stomach showed leucocytes and the nuclei of leucocytes, and more rarely some of the constituents of the gastric mucosa. Occasionally yeast cells as well as different micro-organisms were observed.

Sarcinæ or budding yeast were never present. In addition to these microscopical objects coming from the stomach there could be seen pigmented alveolar epithelium from the bronchial mucous membrane and pavement epithelium from the mucous membrane of the mouth, pharynx and esophagus. Kuttner points out that while in typical cases the mucous secretion is neutral alkaline or slightly acid with an entire absence of HCl that in a certain number of cases there is a considerable amount of free HCl. It is apparent that these cases must be considered as mixed forms of gastrosuccorrhea and gastromyxorrhea.



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Intermittent gastromyxorrhea occurs but rarely. Many cases are probably not recognized, inasmuch as the discomfort is not lasting and the attention of the physician is not called to the condition. In this condition the attacks of increased mucous secretion occur at irregular intervals.

*Etiology.* — Kuttner was unable to find any evidence of locomotor ataxia in the cases that he investigated, though the sudden onset of the attacks as well as the sudden disappearance reminds one much of a gastric crisis. In two of his cases the attack took its onset with disturbance in the secretion of the nose. He therefore believes that there is a connection between the affection of the nose and that of the stomach; the mucus of the stomach, however, is not simply mucus which is swallowed, but is in large part secretion produced in the stomach itself.

*Symptoms.* — The attack may begin with prodromal symptoms: headache, loss of appetite, nausea, etc., but more usually begins in the midst of perfect health, often early in the morning soon after awakening.

The most striking symptom of this paroxysmal attack is severe vomiting, which is intractable in the true sense of the word, inasmuch as it cannot be successfully combated by any remedy. The vomited matter consists of large quantities of tough, slimy liquid, finally of bile and intestinal juices, but contains no food remains. In one of Kuttner's cases vomiting of bloody fluid occurred at the height of the attack. Pain in the region of the stomach is not present, or if it is, it is of no moment. During the attack the stomach refuses to retain food, drink or medicine.



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The patient feels wretched, the abdomen is retracted, the pulse small, the tongue dry and the quantity of urine much diminished. The attack may extend over a period of one day or may continue from three to five or even twelve days. The attack usually ceases quite suddenly, and after the cessation of the vomiting, the patient can again take food without any annoyance. The patient enjoys good health during the interval of the attacks and often has none or very slight dyspeptic symptoms. The examination of the gastric contents after a test breakfast in the interval generally reveals a normal percentage of hydrochloric acid and only a slight amount of mucus.

The following cases illustrate the symptoms of intermittent gastromyxorrhea.

A. F., age thirty-four years of age, presented himself for treatment for a digestive disturbance which had existed at times for a period of several years, and which would disable him for a number of days at a time. Without warning and when the patient was apparently in the best of health, he was suddenly seized (and always early in the morning) with nausea and vomiting, which would continue for three to four days, when not even water could be retained. The vomited matter contained large quantities of ropy mucus from the very beginning of the attack, which would increase in quantity, and which was often mixed with bile. The attacks would recur at intervals of every four to six weeks, and would greatly irritate the patient. Between attacks the patient was in the best of health, and did not suffer from the slightest digestive disturbance. The patient was instructed to inform us at once of the occurrence of another attack, and in the mean time a careful examination was made into



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the case. The patient was a robust individual whose heart and lungs were normal. The abdomen presented nothing abnormal; the stomach was not dilated, and the gastric contents showed a total acidity of 48; free HCl .12%; ferments normal. After ten days another attack set in. The patient began to vomit a large quantity of mucus, which began early one morning and continued for two days; the usual remedies, such as small doses of creasote, carbolic acid, cocaine, hydrocyanic acid as well as lavage, proved valueless; suddenly, on the night of the second day, the vomiting ceased. The vomited material consisted entirely of a colorless, occasionally of bile-tinged, ropy mucus; it was alkaline, with a total acidity of 5; the ferments were absent; microscopically the mucus contained leucocytes, a few micro-organisms, and broken-down cells from the gastric mucous membrane.

The second case, T. L., female, age forty-two, presented symptoms almost identical with the case already reported, except that the attacks were ushered in by prodromal symptoms of headaches, lassitude, nausea, and a slight temperature of 99° to 100°, which preceded the attacks for one day. The attacks last five to six days in this case, and appear regularly every six weeks. They are accompanied by great exhaustion and followed by marked weakness. In a third case the attacks always followed a cold in the head, with a coryza suggesting the form described by Kuttner.

*Treatment.* — In the beginning of the attack Kuttner advises a thorough lavage of the stomach, which he believes may terminate the attack, though he recognizes the fact that but little can be gained from this method of treatment, or even by the internal administration of drugs after the



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attack is at its height. In none of our cases did lavage prove of any value at any stage; morphia given hypodermatically often gives temporary relief, and in cases of extreme exhaustion and weakness, normal salt solution enemata or infusions may be indicated. Between attacks attention should be directed to the underlying condition; that is, to the neurotic tendency, and for this purpose change of climate, hydrotherapy, massage and electricity, as well as iron and arsenic, have been recommended by Kuttner. Inasmuch as this disorder may be secondary to diseases of other organs, a careful investigation should be made as to the primary disorder, which, if possible, should be relieved. In one of our cases great relief followed a rest cure extending over five weeks.

### CONTINUOUS GASTROMYXORRHEA.

The chronic or continuous form of gastromyxorrhea is more frequent than the intermittent.

*Etiology.* — This condition may be associated with hypersecretion of acid or with various organic diseases, or may exist as an independent functional neurosis. Kuttner has found it associated most frequently with the chronic catarrhs as well as with those nervous affections of the gastric mucosa in which there is a marked diminution or entire absence of the HCl. He also observed it in typical cases of gastric ulcer, with or without pyloric obstruction. This condition seems to be rather favored by the ingestion of starchy food. The seat of origin of the mucus is not known, but it is probably a mixture of the secretion of the superficial epithelium, and of the mucous glands coming in largest measure from the glands of the pylorus. According to Kuttner it is impossible to determine whether this con-



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dition is always accompanied by a definite lesion of the mucous membrane, but inasmuch as it is frequently associated with hypersecretion of acid, it is evident that, like the latter, it may depend upon nervous influences.

*Symptoms.* — There are no characteristic symptoms and the condition may be discovered in some cases even in which there are no subjective symptoms whatever. The diagnosis is established by the discovery of large quantities of mucus in the fasting stomach, shown to be the product of the gastric mucous membrane, and not originating from other sources, such as the nose, mouth, or pharynx. It is of no importance whether subjective symptoms are present or not. Kuttner examined his patients in the morning, ten to twelve hours after any food had been ingested. Lavage of the stomach the evening before is only necessary if stagnation is present.

*Treatment.* — Lavage should be practiced for the removal of the mucus providing there is no contra-indication to this procedure; instead of this method of treatment Kuttner advises the administration of mineral waters, these being chosen with reference to the nature of the associated disease, the general condition of the patient and of the various gastric functions. The table on opposite page gives a synopsis of the histories of our 12 cases.

REFERENCES.

[1] Ewald: Klinik der Verdauungskr., 1893.
[2] Riegel: Deut. med. Wochenschr., 1893, no. 31 and 32.
[3] Dauber: Arch. für Verdauungskr., Bd. ii, S. 167.
[4] Kuttner: Berlin klin. Wochenschr., Oct. 30, 1905.
[5] Schmidt: Deut. Arch. für klin. Med., 1896, 3.
[6] Tellering: Inaug. Diss., Bonn, 1894.



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| No. | Name. | Age. | Sex. | Symptoms. | Gastric Contents. Total acidity. | Gastric Contents. Per cent free HCl. | Contents from fasting stomach. | Treatment. | Result. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | T. K. | 29 | F. | Pressure after meals<br>Burning in stomach<br>Fullness and distention | 72 | 0.11 | 40–60 ccm. of mucus<br>Total acidity, 6 | Lavage with solution of Agno 3 | Markedly relieved |
| 2 | J. S. | 34 | F. | Fullness and distention<br>Vomiting of mucus | 54 | 0.12 | 25–30 ccm. of mucus<br>Total acidity, 5 | Lavage hydrotherapy | Improved |
| 3 | T. F. | 25 | M. | Eructations of gas<br>Vomiting of mucus | 48 | 0.14 | 30–50 ccm. of mucus<br>Total acidity, 8 | Lavage hydrotherapy | Not improved |
| 4 | F. S. | 48 | F. | Nausea and vomiting of mucus | 76 | 0.20 | 35–40 ccm. of mucus<br>Total acidity, 0 | Carlsbad water cure | Much relieved |
| 5 | P. T. | 52 | F. | Sick headaches and eructations | 62 | 0.18 | 40–80 ccm. of mucus<br>Total acidity, 0 | Lavage with solution of Agno 3 | Not relieved |
| 6 | F. B. | 31 | M. | Vomiting of mucus | 58 | 0.16 | 50–60 ccm. of mucus<br>Total acidity, 4 | Lavage hydrotherapy. Belladonna | Relieved |
| 7 | G. R. | 58 | M. | Pressure and distention | 40 | 0.10 | 30–40 ccm. of mucus<br>Total acidity, 0 | Lavage with solution of Agno 3 | Much improved |
| 8 | L. E. | 43 | F. | Distention after meals<br>Heartburn | 78 | 0.22 | 45–55 ccm. of mucus<br>Total acidity, 0 | Lavage with solution of Agno 3 | Not relieved |
| 9 | M. G. | 38 | F. | Nausea and vomiting | 40 | 0.11 | 40–50 ccm. of mucus<br>Total acidity, 8 | Lavage | Not relieved |
| 10 | T. S. | 31 | F. | Neurasthenia and pressure in stomach | 52 | 0.15 | 35–60 ccm. of mucus<br>Total acidity, 0 | Lavage with solution of Agno 3 | Much improved |
| 11 | I. F. | 42 | F. | Nausea and vomiting | 46 | 0.13 | 30–45 ccm. of mucus<br>Total acidity, 0 | Carlsbad water cure | Improved |
| 12 | M. E. | 47 | F. | Vomiting of mucus | 48 | 0.14 | 45–70 ccm. of mucus<br>Total acidity, 4 | Lavage with solution of Agno 3 | Markedly improved |

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# A COMPARISON OF THE GUIAC AND BENZIDIN TESTS FOR INVISIBLE HEMORRHAGE IN DISEASES OF THE DIGESTIVE ORGANS.

FRANKLIN W. WHITE
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The clinical value of the recent delicate tests for blood in stomach contents and feces is so well known that the subject needs no introduction. It is very important to recognize and use the best method, the one which is at the same time most simple and easy to perform, most free from sources of error, and which is delicate, but not over delicate. We have chosen two for study and comparison, namely the guiac and benzidin tests, and some of the recent modifications proposed.

In the original test proposed by VanDeen the guiac and peroxyde were added directly to the material to be tested for blood (gastric contents, feces, urine, etc.) A positive reaction was obtained with many substances beside blood, e. g., uncooked food, body products, and drugs. Two methods are used to exclude these substances; first, making an acetic acid ether extract of the material (Weber test); second, boiling it. No method is entirely above reproach which lacks such a preliminary step.

We have investigated several modifications of the original technique.

## GUIAC TEST.

Benedict's method consists in adding tincture of guiac, old turpentine, and gasoline directly to the feces to be tested after mixing the latter with a little water. This is practically the old



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VanDeen test plus gasoline, and is open to all the sources of error of this original test.

Schumm's method consists in a very thorough preliminary extraction of the feces with alcohol and ether to remove coloring matter, fats, fatty acids and water before applying the usual Weber test to the residue. This is far too elaborate and tedious for routine clinical work.

Cowie's method. To render the test more delicate an equal amount of distilled water is shaken with the acetic acid ether extract before adding the guiac, also the glassware used in the test must be perfectly dry as well as clean. We have repeatedly compared Cowie's modification with the ordinary Weber test and have *not* found it more delicate. It is difficult to undestand why *dry* tubes should increase the delicacy of the test when we are examining material which consists chiefly of water.

Schroeder's method. Schroeder states that each strength of blood solution has an optimum strength of guiac tincture. Where large amounts of blood are present a strong guiac solution should be used. With small amounts of blood a weak solution of guiac is best. We have found this statement to be true. Instead of three solutions of guiac which he advises, it is much simpler to use ten, two and one drops respectively of the same usual tincture.

Diet. Test for blood in gastric contents and feces are not conclusive unless the patient is on a blood free diet.

Delicacy. In our hands the guiac test has the following delicacy, using the simple Weber acetic acid ether extract and considering no reaction positive unless a clear blue or violet color was obtained.

Watery solutions of fresh human blood, 1/5000-1/8000.

Blood in gastric contents, 1/1000-1/3000.



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Blood in feces, 1/200-1/500.

Three grammes of blood given by mouth gave a positive test in the feces. The delicacy of the test is not an absolute fixed quantity, but depends somewhat upon the individual digestion, the amount of fecal and vegetable pigments present, the individual technique of the test and the reagents.

The Benzidin Test was at first directly applied to a considerable amount (3 cc.) of the material for examination. This gave a positive reaction with one part of blood in two hundred thousand, which is much too delicate for clinical use. Several modifications have been proposed, one of the best is, Schlesinger & Holst's method. This reduces the delicacy of the test by using a much smaller amount (1 to 3 drops) of the material for examination, and excludes oxydizing ferments as a source of error by boiling. The method is quick and very simple. The ether extraction of the guiac test is replaced by the quick method of boiling; it is distinctly more delicate than the Weber guiac test. It has been objected that short boiling of the material to be examined will not destroy the food ferments and prolonged boiling will decompose some blood and lessen the delicacy of the test. Neither of these objections is valid in my experience. It has been said that occasionally the reaction is doubtful because minute floating particles are colored green while the mixture as a whole is colorless. This very rarely occurs and is practically always due to traces of incompletely destroyed ferments which cling to particles of food. Filtration before the test excludes these and never excludes free blood pigment.

The Einhorn Paper Test uses a filter paper dipped in a solution of benzidin in acetic acid and dried. This test is peculiar in the fact that the characteristic color develops in a few minutes in



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the presence of many other substances besides blood. Einhorn states that the reaction is more prompt with blood and a time limit of one minute is set; a blue or green color within this time is considered positive, after one minute is negative. Even this restriction is not altogether satisfactory, and Einhorn advises that only negative and strong positive reactions be disregarded.

My experience coincides with the above statements, but is less satisfactory. Color changes were obtained frequently and promptly in the presence of peroxyde alone and of many food materials whether cooked or raw. With strong blood solutions the color was always clear and sharp with fresh paper. In weak solutions the color lacked sharpness. The paper when kept for months became darker and harder and lost in delicacy. The test was confusing as it was hard to know where to draw the line both in time and color; I much prefer the benzidin solution.

Diet. Meat and fish and their juices must be excluded as in the guiac test and a little longer, at least three or four days. It is essential to boil (or filter and boil) gastric contents before testing to exclude food ferments. Boiling the feces is very rarely necessary for this purpose, but should be done if the unboiled feces are positive.

Delicacy. I have tested the delicacy of the Schlesinger & Holst's modification with fresh watery solutions of human blood and with mixtures of fresh blood with gastric contents and with feces. I have applied the test in two ways, either by adding the two or three drops to be tested to the peroxyde mixture and shaking it once, in which case the color develops through the whole mixture; or by adding the drops without shaking the mixture, in which case a deep ring of color develops only at the top. The latter method gives a sharper result with weak solutions of blood and is somewhat more delicate.



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The results were as follows:

Watery solutions of fresh blood

| | | |
|---|---|---|
| | Ring Test | 1/40000—1/80000 |
| | Shaken | 1/10000—1/20000 |

Blood in gastric contents

| | | |
|---|---|---|
| | Ring Test | 1/20000 |
| | Shaken | 1/10000 |

Blood in feces

| | | |
|---|---|---|
| | Ring Test | 1/1000 |
| | Shaken | 1/500 |

In comparison with the guiac test the benzidin test is about five to seven times as delicate for blood in watery solutions and gastric contents as the guiac test, and about twice as delicate for blood in the feces. The objection that the test is too delicate for clinical work is removed by the use of the Schlesringer and Holst's modification.

I will summarize some typical results where feces were examined.

Thirty-nine examinations of stools of healthy persons on a meat free diet gave an invariably negative result.

A hundred examinations in functional diseases of the stomach and bowel on the same diet gave an invariably negative result.

Sixty examinations in 17 cases of gastric ulcer gave intermittent positive results. The stools usually became negative for blood in about ten days after hospital treatment was begun in cases of acute gastric ulcer in young women with hematemesis.

The stools (14 examinations) were occasionally positive in four cases of severe benign pyloric stenosis and became negative after operative relief.

Thirty-five stools in six cases of gastric cancer were all positive.

Of 69 tests which were positive with benzidin, all but nine were positive also with guiac.

The value of the test is evident. Its negative results in healthy and functional cases; its value



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in the diagnosis of ulcer and cancer and as a measure of the results of treatment of ulcer and pyloric stenosis.

The chief advantage of the benzidin over the guiac test is the greater value of the negative results in ruling out all hemorrhage, the much greater ease and rapidity of its performance and the greater clearness of the color reaction in the feces. The points which I wish especially to emphasize are as follows:

1. These tests are important and likely to be much used.

2. Sources of error from food ferments and other substances in the alimentary canal are much greater in the guiac than in the benzidin test. With the guiac test some preliminary step is always necessary to exclude them. With the benzidin test this is necessary for gastric contents and but rarely necessary for feces. It should be included however, when fresh feces are positive.

3. The Weber method is the best guiac test for routine clinical work, using several amounts of guiac as recommended by Schroeder.

4. Schlesinger and Holst's modification is probably the best benzidin test for clinical use. It has all the clinical value of the guiac test with somewhat greater delicacy, greater clearness, and much simpler technique, and as carried out, acts as a control on the cleanliness of reagents and glassware.

5. Before using this test, meat, and fish, and their juices must be excluded from the diet for three to four days.

6. Feces are the best material for examination, as they alone are available for the repeated examination which is usually necessary for diagnosis and treatment.

7. It is wise to control the benzidin test with the guiac test when positive results are found, until the technique is learned and tested individually.



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## DISCUSSION.

Dr. Henry Wald Bettmann, Cincinnati: The paper of Dr. White is an extremely helpful one. In common with many others, I adopted the Schlesinger and Holst modification of the benzidin test as soon as it was published, and have used it almost exclusively during the past season, and I was glad to hear the critical analysis of the subject which Dr. White gave. I adopted the method on account of its ease and clearness, and I have also taken the extra precaution of excluding from the patient's diet all green vegetables for a few days prior to making the test.

I used the benzidin test papers which Dr. Einhorn demonstrated at the last meeting, but gave them up on account of the uncertainty of the reaction and the time limit.

Dr. White did not mention the necessity for excluding the use of the thumb or fingers in shaking the test-tube. The perspiration from the fingers may produce a positive reaction in an otherwise negative case.

I would like to ask Dr. White what his experience with this test has been in carcinoma? In some of the cases under my observation, the test of the feces has not been uniformly positive. I would ask whether the ones he referred to were far advanced cases, in which ulceration had probably occurred, or whether he secured a positive reaction in some of the earlier stages of carcinoma? I have several times missed it in carcinoma of the esophagus and in early cases of carcinoma of the stomach.

Dr. John P. Sawyer, Cleveland: Dr. White's paper emphasizes how carefully we should scrutinize our methods, and I wish it might be generally known how very sensitive this reaction is. The author of the paper has certainly done us a great service in calling our attention to some of these points. It is not easy to find in this country assistants who can properly be relied upon to do this work, and the references we find in literature as to whether the benzidin test was negative or positive practically mean nothing unless we know the men who carried out the work.

Dr. John A. Lichty, Pittsburg: In cases of suspected gastric ulcer or carcinoma, the test for blood in the feces may prove negative in patients whose mixed diet has been stopped, and the stomach put at rest by giving them nothing but milk. This may cause the slight hemorrhages from which these patients might otherwise have suffered to stop, and after three or four days, no blood would be found. In such cases, I do not always feel comfortable about the result, and am rather inclined to believe that a positive reaction would have occurred if the hemorrhage had not been checked by such a bland diet. I would ask Dr. White's opinion in regard to this matter.

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Dr. Franklin W. White, Boston: (Closing the discussion.) The question of whether to exclude or allow green vegetables in the diet seems to me can be decided in this way: In green vegetables, the oxidizing ferments are practically destroyed at the time they are passed through the alimetary canal, and I do not think it is necessary to exclude them for special examination. I have found that green vegetables, even with the gastric contents, interfered very little with the test, and if we filter and boil the contents, we can safely allow them.

I am glad Dr. Bettman's experience in regard to the benzidin test-papers has been confirmatory of my own. In making the test described in my paper, the fingers should not be used to close the test tube when it is shaken, rubber stoppers should preferably be used, to avoid a possible positive reaction due to sweat, etc.

The carcinoma cases in which the results were invariably positive were chiefly well-advanced cases. In the early stages of gastric carcinoma we may have intermittent blood in the stools, but with a good sized ulcer the bleeding will be more or less continuous. With cancer of the bowel, the bleeding will be more intermittent than with cancer of the stomach. This has been the experience of observers abroad, as well as my own. Tubercular lesions of the bowel will of course give positive results. This test will not make the diagnosis for us; it will only show us the presence of an ulceration, but not the kind.

In reply to Dr. Lichty's remarks as to the possibility of stopping the bleeding from an ulcerated surface by reducing the patient's diet, I do not think that objection will really hold in a practical way. The only reduction that I have made in the diet of these patients is to leave out meat, fish, and the broths and juices from these foods. I leave in the vegetables, which are even more liable to irritate the surfaces than are the ordinary digestible meats. I give my patients a fairly mixed diet, referring now to chronic ulcer or carcinoma, not of course to acute ulcer.

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# TREATMENT OF GASTRIC ULCER*

By J. W. Bell, M. D.

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MINNEAPOLIS

The first step in the successful management of gastric ulcer is an early and complete diagnosis, which should include not alone the diagnosis of ulcer, but its exact location, and the secondary changes in the stomach due to its presence.

Clinically, gastric ulcer is met with in two forms: (1) the acute, non-indurated ulcer; (2) the chronic indurated ulcer. The treatment of the first form, acute ulcer, belongs entirely to the internist, with the exception of cases characterized by severe and uncontrollable hemorrhage, and cases of acute perforation. The treatment of the second form, chronic indurated ulcer, frequently becomes surgical, consequently the internist should associate with himself a skilled surgeon in all cases complicated by pyloric stenosis, adhesions to surrounding structures, chronic hemorrhage, dilatation with food retention, and all cases where the suspicion of beginning malignancy exists.

Surgery is called for in ulcer mainly to relieve secondary results, that is, to stop uncontrollable hemorrhage, to save life in case of perforation, to relieve pyloric stenosis and adhesions, and to secure drainage of the dilated stomach when marked food-stasis exists. In the interest of the patient, which should, under all conditions, be the first consideration, it becomes the duty of the internist to associate with himself a skilled sur-

*Read before the American Gastro-Enterological Association, at Chicago, June 1, 1908.

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geon, especially in complicated cases of chronic ulcer, in order to promptly meet complications and sequelæ.

Medical failures are due, mainly, (1) to late and incomplete diagnosis, (2) to faulty or insufficient treatment, (3) to carelessness or disobedience on the part of the patient.

In the medical treatment of gastric ulcer we should keep constantly before us the fact that there is no specific, and that the ulcer heals by virtue of the power of repair in the body, aided by complete rest of the organ involved. The therapeutic indications are (1) absolute rest of body, mind, and stomach; (2) careful feeding, gastric and rectal; (3) treatment of symptoms and complications. While the therapeutic indications remain practically the same in all cases of gastric ulcer, it is equally true that each and every case is a law unto itself, and demands the most careful study and investigation, in order to secure the best obtainable therapeutic results. Rest, first suggested by Brinton and later emphasized by Leube, is the first essential. A patient suffering from gastric ulcer should be put to bed, and absolute rest enjoined for a period of from two to four weeks, depending on the requirements of the individual case, or until such time as the characteristic pain and discomfort due to the taking of suitable liquid or semisolid food shall no longer appear. The rest-cure for ulcer does not mean, at least in the majority of cases, the strict isolation required in severe forms of neurasthenia. During this period they should receive daily alcohol sponge-baths and guarded general massage, avoiding the abdomen, with the view of improving their general condition.

In addition to this general bodily rest in bed, complete local rest for the stomach is absolutely necessary for a period of from seven to fourteen days, depending somewhat on the severity of the case. During this period nothing but water should be swallowed. Should thirst be especially trouble-



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some, water may be given in the form of saline enemata.

Before commencing rectal feeding, the colon should be cleared by high lavage, using two or three quarts of warm normal saline solution, repeated each day thereafter before using the first or last of the three daily nutritive enemata. One-half hour after thorough clearing of the bowel, the regular nutritive enema should be given, and repeated every six hours, the third and last one for the day to be given not later than 9 P.M. The nutritive enema should not exceed six ounces of milk and one egg, both to be thoroughly peptonized, which means at least two hours of predigestion before using. Immediately before using, add one ounce of some standard peptone and a half teaspoonful of salt, also alcohol if indicated. If the enemata are not well born, or if the rectum becomes irritable, codein or opium, in small doses, may be added with advantage. A small amount of the normal saline solution, used each morning to clear the bowel, is absorbed, which tends to diminish thirst, but it is often necessary to inject from eight to ten ounces into the bowels two hours after the evening nutritive enema, in order to lessen thirst. During this time calcined magnesia, milk of magnesia, or Carlsbad salts may be used to gently regulate the bowels and lessen acidity.

Rectal feeding should be continued from one to two weeks, depending on the requirements of the case, at the end of which time, provided the local tenderness and pain have largely disappeared, a small quantity of thoroughly cooked oatmeal gruel, previously strained, may be cautiously given by the stomach, or a small amount of cream and Vichy, in the proportion of one to three, may be given once in twelve hours, gradually increasing the amount as well as the frequency of feeding from day to day, later adding egg albumen, eggs, beef juice, and well-cooked cereals. As we increase the gastric feeding we



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decrease the rectal feeding. For weeks, extreme care should be used in the selection of food, adding only one additional article of food at a meal, in order that we may know the offending article of food, if gastric discomfort follows.

I have purposely omitted milk, peptonized, boiled, or raw, from the list of foods suitable for gastric feeding in the early days of the treatment of acute ulcer. I am convinced that milk is a much over-rated food in all acute gastro-intestinal disorders, and is by no means the ideal food in cases of acute ulcer, especially during the early days of gastric feeding, following the period of enforced gastric rest. While milk is an innocent fluid outside the stomach, it soon becomes a solid in these usually hyperacid stomachs, often being promptly returned in the form of a tough curd. If milk is used it should be thoroughly peptonized, or boiled, and slowly sipped with a spoon. Cream diluted with three parts of Vichy is an excellent substitute for milk in the early period of the ulcer cure, especially in cases marked by pronounced hyperchlorhydria. In my experience cream and Vichy, well-cooked cereals, and egg albumen are better born by ulcer patients than milk, during the first period of gastric feeding. In a certain percentage of cases, marked by extreme hyperacidity, alkalies are indicated, to neutralize the excess of hydrochloric acid and to relieve the pain and gastric discomfort.

Hemorrhage is often the first definite indication of ulcer, and when the amount of blood lost is not excessive, a period of absolute rest of body and stomach, aided by bits of ice internally, and the ice-bag externally, usually suffices to control it. If the hemorrhage is severe, morphine, in small doses, sufficient to secure physical and mental quietude, is exceedingly beneficial. In case clotted blood in large amount is retained in the stomach, careful lavage with very hot water, in order to promptly clear the stomach, followed by a solution of adrenalin chloride, 1 to 5,000,



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permitting it to remain for a short time before removing with the tube, is an efficient method of checking hemorrhage. If hemorrhage recurs in sufficient amount to endanger the life of the patient, surgical advice should be sought with the view of immediate operation. Personally, I insist that a skilled surgeon shall see my patient as soon as possible after the occurrence of a severe gastric hemorrhage, not with a view of immediate operation, but for the purpose of becoming familiar with the patient's condition, that he may be prepared to act promptly in case the hemorrhage is sufficient to endanger the patient's life. If perforation occurs, immediate operation offers the only hope of relief.

Bearing in mind the danger of relapse, we should impress upon our patients the necessity for extreme care in the selection of food for some months. These patients should be urged to eat slowly, masticate thoroughly, avoid frequent eating, and, under all circumstances, to avoid overeating, one large meal being sufficient to undo the work of weeks.

In acute gastric ulcer the importance of an early diagnosis cannot be too strongly emphasized, in view of the fact that an early diagnosis means a prompt and permanent cure, thus avoiding complications and serious secondary changes in the stomach. Patients suffering from acute ulcer should be impressed with the fact that they are not cured simply because the more important symptoms have disappeared, but, on the contrary, must continue under observation and treatment until all evidence of ulcer has disappeared. In this connection I feel that we physicians are often more at fault than our patients. The desire to rout disease by a brilliant dash rather than by slow siege, is one of our not uncommon errors. Patients should be kept under careful observation and control for at least one year after apparent cure.



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Permit me to reiterate that the treatment of chronic indurated ulcer belongs in part to the skilled surgeon, consequently the internist should promptly refer all complicated cases to the surgeon for investigation and, if deemed best, for operation. In case the ulcer is situated to the left of the pyloric portion of the stomach and but slightly indurated it is a safe rule to give the patient the advantage of the line of treatment suggested for the relief of acute ulcer before considering operation. Unfortunately, 80 per cent of all ulcers are situated within the limits of the pyloric portion, following Mayo's division of the stomach into two parts,—a pyloric or grinding portion, lying to the right of the cardiac orifice, and a cardiac portion to the left.

The fact that in increasing numbers each year these cases of chronic ulcer, after varying periods of improvement, following the operation of gastro-enterostomy, redevelop their former pre-operative symptoms, naturally leads to the inquiry, Is gastro-enterostomy the ideal operation for the relief of chronic ulcer? In my series of referred cases there has been a gradual increase each year, presenting a recurrence of pre-operative symptoms, following gastro-enterostomy. My cases were operated upon by skilful surgeons, consequently no suspicion of imperfect technic would hold.

Direct excision of the indurated ulcer area, thus removing a constant source of distress and danger, would seem the ideal surgical procedure in cases actually requiring surgical interference.

The crying need of the hour is for a sharper line of demarcation between the medical and the surgical ulcer. I am convinced that many patients are subjected to the ulcer cure, who have never had ulcer, and not a few have been operated upon who would have been vastly better off under medical treatment, all of which indicates that the ulcer problem is not fully and completely solved.



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## CONCLUSIONS

The following conclusions regarding the management of gastric ulcer would seem warranted:

1. That an early and complete diagnosis is the first essential in the successful management of gastric ulcer.
2. That all cases of acute gastric ulcer are amenable to proper medical treatment, the only exceptions being cases characterized by uncontrollable hemorrhage and perforation.
3. That all uncomplicated cases of chronic ulcer are amenable to proper medical treatment and should be so treated.
4. That chronic indurated ulcers of long standing, involving especially the pyloric portion of the stomach, including their complications and sequelæ, frequently demand surgical interference.
5. That the end-results following gastro-enterostomy for the relief of chronic ulcer are not satisfactory.
6. That the ideal surgical treatment of chronic indurated ulcer is excision in some form.



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## DISCUSSION.

DR. GUSTAV FÜTTERER, CHICAGO: A profuse gastric hemorrhage, as a rule, is not as dangerous as repeated small hemorrhages, and the latter oftener call for surgical interference than the former.

DR. JOHN P. SAWYER, CLEVELAND: In addition to what has already been said in the discussion of Dr. Bell's paper, there are one or two little practical points bearing upon the comfort of the patients to which I wish to refer. We know that the use of rectal injections for feeding purposes is often irritating and troublesome to the patient, and I have found that the injection of five grains of othorform in two drams of olive oil, given half an hour before the food enema, often relieves to a considerable degree the attendant distress.

In the treatment of acute gastric ulcer, I believe it advisable to give the stomach a short period of rest, and rely upon rectal feeding. I have made this period shorter than formerly, but I believe that a complete physiological rest for the stomach under these conditions is of advantage, but at the same time I do not by any means wish to be understood as under-estimating the importance of introducing the greatest possible amount of nourishing food into the body at the earliest possible moment. After what I have listened to here today, I will perhaps be willing to temper my views in regard to the importance of giving the stomach in these cases a rest of three or four days but I still believe in the advantage of a certain period of complete physiological rest, and the patient who rests in bed will I think have vaso-motor rest—physical rest, which is one of the purposes of his confinement. The application of oil or borated vaseline over the abdomen of these patients will, I think, contribute to a more uniform circulation within the abdomen. After such an application, the abdomen can be covered with gauze or hot applications or the electric pad; the warmth thus applied will stimulate the circulation, favor the increase of hemaglobin, and perhaps favorably affect the healing of the ulcer.

DR. J. W. BELL, MINNEAPOLIS: (Closing the discussion). I wish to thank the members for the full discussion the paper has brought out; it was presented for that very purpose. While I am not inclined to refer cases of gastric ulcer to the surgeon as frequently now as I did in former years, I still hold that chronic ulcer is a condition which calls for the association of the surgeon with the internist under certain circumstances. I think the surgeon so associated should be skilled in that particular line of work.

We all know how much time and labor Dr. Fütterer has devoted to this subject, and how well grounded he is in everything that pertains to its etiology and pathology, and yet I confess that I feel very much as our President expressed himself in regard to the advisability of giving the stomach at least a short period of rest after the

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occurrence of hemorrhage especially in the management of acute gastric ulcer. The length of that period should depend on the nature of the case.

I have had no personal experience with the Lenhartz' method of treatment, but I confess I have never been able to get up sufficient courage to freely feed a patient by the mouth within 24 hours after the occurrence of a sharp gastric hemorrhage. I do not regard it as the wisest thing to do, and I should personally hesitate to do it.

In dealing with a case of uncontrollable gastric hemorrhage which is so severe as to endanger the life of the patient, I think we are justified in calling to our aid the services of a skilled and conservative surgeon. Irrespective of the existence of an open chronic ulcer, I think the surgeon should at times be called to correct defects in the stomach resulting from a chronic ulcer.

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